PAVING AND MUNICIPAL ENGINEERING.

A Journal Devoted Specially to Street and Sidewalk Paving, Sewerage, Water-Works Construction, Street Lighting, and all Matters Pertaining to Municipal Engineering.

Published on the 15th of Each Month.

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OFFICE: ROOM 44, CHAMBER OF COMMERCE, - - - INDIANAPOLIS, IND.

Entered at the Post-office, Indianapolis, Ind., as second-class matter.

SUBSCRIPTION: { One Year, ... $1 00. Single Copy, ... 10.

FOREIGN SUBSCRIPTIONS.

Great Britain and Australia...6 s. sterling. | Austria.....4 florins.
France.....8 francs. | Germany.....6 marks.

Advertisements to insure publication should reach the publication office not later than the 5th of the month.

Communications are invited, and all requests for special information on the subjects treated by this journal will receive careful attention.

Articles relating to the different branches of municipal engineering are desired. Stamps should accompany manuscripts for return postage if unavailable.

Vol. II. INDIANAPOLIS, IND., JANUARY, 1891. No. 8.

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The columns of this publication are open to the discussion of all subjects relating to paving, sewerage, water-works, street-lighting, and the physical improvement of cities. Practical information as to the merits of materials used in such work and new methods, with photographs and drawings, which may be used for illustration, are especially desired. We are glad to get brief notes as to proposed improvements and the letting of large contracts.

City engineers are requested to send us as early as possible copies of their annual reports, which will be given proper notice.

Articles relating to methods of road making and maintenance are invited.

VIEWS OF FRENCH, GERMAN AND BRITISH ENGINEERS ON STREET PAVING.

By Louis H. Gibson, Our Special Representative in Europe.

DURING the last few weeks I have been studying pavements in a comparative spirit, and particularly from the point of view of those interested in asphalt. In that connection it is well to understand that the views, coming as they do from French, German and English engineers who are prejudiced in favor of asphalt, are destined to be considered with more or less prejudice. Yet, at the same time, no one can say that these engineers are partisans, that they are unfair or narrow in their views of pavements. One French engineer, who has devoted his life to the advancement of asphalt, states that there is only one other pavement which is deserving of comparison with asphalt, viz.: The wooden block pavement.

His statement of the ideal pavement is that it should be one smooth and with certain elasticity under travel at the same time that it is sufficiently firm and solid to readily drain itself and be susceptible of economical and perfect cleaning. It must also meet hygienic requirements. He states that wooden block pavement has, to a certain extent, the elasticity demanded of a first-class pavement, but affirms that it is more expensive than asphalt, both as to first cost, as well as cost of maintenance, is quite slippery in wet weather and not so readily cleaned nor perfectly drained as asphalt. He further states, with great emphasis, that a wooden block pavement is by no means hygienic.

In speaking of asphalt pavement this engineer says that it has the resistant quality which meets the ideal of a first-class pavement; that it is smooth, drains naturally and is susceptible to thorough purification and cleansing by ordinary street cleaning methods; that it is non-absorbent, for which reason it readily dries after showers and does not hold, in a noxious form, any of the street impurities. Anything that remains on the surface, even for a short time, soon becomes dry if it is not washed into the sewer. Under either of these conditions they are not disturbing nor dangerous.

In speaking of the relative cost of asphalt and wooden pavement, the writer says that he can remove himself outside the bounds of prejudice because of personal interest in asphalt, by making an actual exhibit taken from the accounts of the city of Paris, which are nothing more or less than absolute records of costs and expenses. The figures, as he gives them, though doubtless far from being relatively the same in America, are on the basis of one square metre, a metre being a little over thirty-nine inches, as follows:

Asphalt, two inches thick on Portland cement, six inches thick	$3 90
Cost of caring for, in repairs, per annum, after twenty months of gratuitous care	40
In certain streets, where traffic is exceptionally heavy, like Rue Richelieu and Rue St. Honore, the asphalt is two and one-half inches in thickness, and the concrete eight inches in thickness. The cost established for these streets is	4 60
The cost of repairs, after the period of twenty months gratuitous attention, is the same as for other streets	40

To compare with the above are the following figures for paving in wood:

Blocks on a cement base	$4 60
Repairs after six months gratuitous attention	59
The above amount is for repairs on streets with the heaviest travel. Those with lighter travel	52

Professor Deitrich, who was sent from Berlin by the German government, for the purpose of examining the pavements of London, Paris, and the most popular cities of America, returned to his country with a condemnation of all pavements in wood, and recommended that the streets so paved in Berlin be repaved with asphalt.

Even our engineering authorities in Paris, who are particularly interested in asphalt, do not agree with the severity of this recommendation. It is stated that his judgment must have been largely formed by observations where sufficient care had never been taken,

either to prepare the wooden blocks before laying, or to give the pavement a good foundation. The foundation for wood, as for all other pavements, demands the most serious attention. The writer on asphalt states that the experience in Paris with wood does not justify the severe condemnation which it received from Professor Deitrich.

I have before me the report of Colonel Haywood, Engineer in Chief of the city of London, upon the roads of asphalt comprime of that city. He says the value of asphalt pavements may be considered under the following general heads: Convenience and comfort of travel, hygiene, ease of cleaning, facility of construction and repair, and costs.

As to convenience and comfort of travel, Colonel Haywood affirms that vehicles can move much more rapidly, with less effort to the horses and more comfort to the travelers, than over any other road, consequently there is less fatigue to the horses and as well to those who ride. Asphalt being impermeable to moisture, it more quickly recovers from a slippery state after rain or sprinkling. Under the heading of hygiene, he covers about the same ground as the French engineer, though under that heading he enlarges by considering the effect of the slipping of horses on wood, asphalt and stone. He states that if the asphalt pavement were perfectly clean, that even when wet it is not so slippery as either of the other two pavements mentioned, and that from the fact that asphalt may be more readily kept clean than any of the others it is less liable to be slippery when wet. He also claims that while horses will get up less quickly when they fall on an asphalt pavement than on wood or stone, they are less seriously injured.

Under the heading "construction and repairs" he covers about the same ground that has been gone over in these articles in PAVING AND MUNICIPAL ENGINEERING. The costs are not greatly different from those given for Paris pavements.

In connection with the above it may be of interest to know that not a great deal of asphalt pavement is being placed in Paris during this year. The new pavements on the important streets are of wood. Parts of Avenue de L'Opera, Rue des Capucines, Boulevard St. Germain, and many other great streets, are either being repaved or extended in wood. Avenue de L'Opera and Rue des Capucines are being repaved, an old wood pavement being taken up and a new one being put down on the old foundation. The pavement on Boulevard St. Germain, that is being placed this year, is an extension of the pavement begun a few years ago. The pavements on Avenue de L'Opera and Rue des Capucines are of the ordinary blocks dipped in creosote as a preservative. They are laid on a seven-inch bed of Portland cement concrete. They are carefully arranged with a quarter-inch space all around, separating each block from the others. Into this opening is poured pitch to the depth of one inch, on top of which to the surface is poured a liquid cement mortar. This differs slightly from the pavement on Boulevard St. Germain, in that in the latter no pitch is used, all of the space between the blocks being filled with a Portland cement mortar, as above.

PROPOSED COMPETITIVE TRIAL OF ROAD MACHINERY.

THE regular December meeting of the Engineering Association of the South was held at the new headquarters of the association in the Cumberland publishing house, Nashville, Tenn., on the evening of December 10. Mr. Hunter McDonald, of Atlanta, Ga engineer in charge of the Western & Atlantic R. R., presided.

Mr. Olin H. Landreth brought before the association for consideration, the question of instituting under the auspices of the association a competitive trial of machinery used in highway building, such as graders, ditchers, surfacers, rock crushers, steam and horse rollers, etc. After an extended discussion by Messrs. S. C. Lewis, Hunter McDonald and W. H. Lyle, which in the main was favorable to the enterprise, a committee was appointed by the chair to investigate and report at the next regular meeting the feasibility of instituting the competitive trial proposed. Messrs. Olin H. Landreth, W. G. Kirkpatrick and J. A. Fairleigh comprised the committee.

NATIONAL BRICK MANUFACTURERS' ASSOCIATION.

THE sixth annual meeting of the National Brick Manufacturers Association, which will be held in Washington from the 12th to the 16th of this month, promises to be one of the most interesting in the history of the organization, and the indications are that it will be largely attended. The programme is as follows:

FIRST SESSION, TUESDAY, 2:30 P. M.

Roll-call. Enrollment of new members.
President's Annual Address—J. C. Adams, Indianapolis, Ind.
Report of Officers. Election of Officers. Installation of Officers.

1. Essay—"Brick and Tile Burning." R. M. Greer, Tuxpam, Mexico.
2. "A Year's Lessons." General discussion, led by Anthony Ittner, St. Louis, Mo.

NOTE: At the close of each address or essay, the subject under consideration will be fully discussed.

TUESDAY EVENING, 8 O'CLOCK.

Fourth Annual Pow-wow, under the auspices of the Washington Brick Manufacturers' Association, will be held in the Convention Hall. B. H. Warner, Master of Ceremonies.

SECOND SESSION, WEDNESDAY, 9:30 A. M.

3. Address—"Use and Abuse of Brickmaking Machinery." W. R. Cunningham, Frankfort, Ind.
4. Essay—"Mixtures of Clay." Robert Lyle, Woodbridge, N. J.
5. "Making and Handling Front and Ornamental Brick." Discussion led by James H. Beggs, Wilmington, N. J.

Reports of Standing Committees.

THIRD SESSION, WEDNESDAY, 2:30 P. M.

6. Essay—"Brickmaking, Ancient and Modern." Thos. Moulding, Chicago, Ill.
7. Address—"Drying Brick." Ed. Callaway, Syracuse, N. Y.
8. Address—"Organizations of Brickmakers." Edwin McGraw, Pittsburgh, Pa.
9. "Profit and Loss in Brickmaking." Discussion led by J. B. DeHaven, Akron, Ohio.
10. Question Box.

FOURTH SESSION, THURSDAY, 9:00 A. M.

11. Essay—"The Soft Clay Process." —— ——.
12. Address—"The Signs of the Times." J. A. Snell, Barrington, R. I.
13. Essay—"Paving Brick." G. H. Brown, Sioux City, Iowa.
14. Address—"Hand *v.* Machine Work." Jas. Dingee, Philadelphia, Pa.
15. "Does It Pay to Insure Against Casualties?" Discussion led by J. C. Adams, Indianapolis, Ind.
16. Question Box.

FIFTH SESSION, THURSDAY, 2:30 P. M.

17. Essay—"Burning Brick." Wm. H. West, Washington, D. C.
18. "Some Essentials to Success in the Use of Oil as a Fuel." Discussion led by ——.
19. Address—"Labor Troubles—How to Avoid Them." D. G. Harriman, New York, N. Y.
20. Question Box.

Reports of Committees.
Miscellaneous Business.

FRIDAY

There will be a free excursion on the splendid iron steamer "Macalister," to Mt. Vernon, the home and burial place of the immortal Washington. If the weather is propitious this will be a most enjoyable feature. Other side trips, such as a reception at the Executive Mansion, and visits to the brickyards are contemplated.

The general headquarters of the Association will be at Willard's Hotel.

GOOD ROADS.

By Isaac B. Potter.

YOU will agree with me that your roads are bad. You may not know that they are the very worst in the world; but you have never seen or heard of worse ones; nor, alas, perhaps of better. You live on the main road in an important county. I saw you one day last spring trying to drive your best horse through the pasty depths of that mysterious streak of public territory, and while the patient beast was pulling the harness in two, in his efforts to lift you and your scant load on to the little bridge near the mill.

It is an honest picture—as honest as the sun; let us sit down together and look at it. You will notice that your face is turned the other way, and I promise not to tell anybody who you are; for I feel that the day is soon coming when every American farmer will look upon that picture with some regret, and I have no desire to humiliate a friend; besides, it is not your fault alone that this road is bad, nor is it this road alone that presents a sea of slush and slime throughout each rainy season.

There were 10,000 farm horses in your county on the day when this photograph was taken, and for about four weeks all the county

roads had been in just this condition. Teaming was out of the question; to haul a load to town was impossible, and the 10,000 farm horses stood in their stalls "eating their heads off." At what cost to the farmers? Assume that the cost of keeping each horse is twenty-five cents per day, including labor, food, and all other items, and in half a minute we compute that it costs $2,500 per day, $17,500 per week and exactly $70,000 for the four weeks that these horses have been standing practically idle. A bad road, you see, is an expensive thing.

It is expensive not alone to the farmers of your county, but to the famers of the entire country. The average rain-fall in the United States is something over forty inches per year. The dirt road absorbs these forty odd inches of water, freezes and thaws, dries, pulverizes, changes from paste to powder and back again from powder to paste, and for weeks at a time is practically impassable. Farm traffic is tied up. You have produce to sell, purchases to make, grain to grind, timber to haul, bills to collect and obligations to meet, but all these must wait because your only avenue of travel is taking its annual soak. A dozen times a day you look out of your barn door with the hope of seeing some struggling vagrant of whom you can enqiure, "How is the road?"

I do not intend to overdraw the picture, for we have agreed together to stick to facts alone, and so I have traveled many miles and gone to much trouble in order that my letter to you might contain only the truth, and I find the country roads to be even worse than I had supposed them to be; worse than you think them to be. They are disgracefully bad almost without exception. One day I said to myself: "Now, there is the great Empire State; she is out of debt, rich, populous, thriving; she has 125 people for every square mile of her territory, nearly 200 incorporated cities and villages, and the value of her farm crops last year was about one and one-half times that of all the New England States combined. I will go up to the capital county of this great state and see what sort of roads New York has provided for her farmers." So one day in April a year ago I went to Albany, and there, almost in the shadow of that magnificent $25,000,000 State-house, I found the farmers of Albany county literaly struggling in a "slough of despond." Here is a picture from an actual sketch made at that time.

Another perfectly honest picture; as honest as the sun. How much do you suppose it costs the farmers of Albany county per day to keep the roads in that condition? The legislature was then in session making laws "for the better government of the City of New York," "for the expenditure of money in the repair of state canals," "for improvement of navigation in the Hudson river," "for the completion of the state capital," "for the maintenance of convicts in the State Prison," and so on, millions for expenses without end, but nothing in behalf of the farmer. I bought an Albany morning newspaper, and found in that a somewhat extended article on the condition of the roads in the state of New York, showing that all rural business was at a standstill; that the farmers were feeding grain to their cattle because it could not be taken to the mill, and that the effect of this condition of affairs was seriously felt by merchants.

From twenty-seven of our states came at that time reports which, without exception, described the public roads to be in a condition not unlike those of Albany county. From one of the wealthiest and most populous western states, a state full of resources and endless possibilities for the farmer, came a photograph, taken on an important country road leading into one of the great cities. I might tell you what city it was, but the scene is no worse than could have been found in the suburbs of a hundred other towns at that time and I have no desire to excite municipal jealousy. Here is the picture. You see the wagon has become hopelessly stuck, and is abandoned by horse and driver. If that horse could talk, what a story we might have! He would tell you a patient tale of pains and trials that you know not of and assure you that a dirt road in a civilized country is as much out of place as a dirt roof.

VITRIFIED BRICK THE ROADWAY OF THE FUTURE.*

By Edward Stabler, Jr.

I BELIEVE it is conceded that the most important subject connected with the future prosperity and healthy growth of Baltimore as a city, is the ever-abiding one of a low rate of taxation, and the burden so nicely adjusted as not to fall heavily upon any one class of our citizens or upon any one interest, commercial or otherwise.

Next to this in importance, as affecting the householder, the taxpaper or the capitalist, and all classes of our citizens, from the merchant prince in his luxurious carriage to the carter or drayman who drives his own horse and vehicle and obtains his living thereby, is the condition of our street beds and roadways.

No one thing more distinctly marks the line of distinction between the provincial town on the one hand, and the progressive and modern city on the other, than smooth, solid, well paved and well-kept streets; and no one thing, perhaps, has a more direct influence upon the desirability and value of real estate, both urban and suburban.

The street that is solidly paved wears the longest, presents the greatest resistance to heavy traffic, and requires the smallest amount of repairs.

*A paper read before the Taxpayers' Association, of Baltimore.

The street that is smooth confers a blessing upon those who drive over its surface, the wear and tear upon draft animals and vehicles is reduced to a minimum, the surface is thoroughly cleansed by every rain, and can be kept clean with the hose or the street-sweeping machine. There is no incessant roar and noise of traffic, that all medical men unite in saying shortens the lives of those who live in cities, besides producing and aggravating many forms of disease; while, if the material be not only smooth and non-absorbent but made water-proof, the foul substances deposited on the streets will not soak into the ground to rise in poisonous exhalations with the heat of summer, engendering zymotic and other diseases, as is the case with the cobble or rubble stone pavements, and to a lesser degree only with the Belgian block pavement, unless laid by the "Camp" patent process, that is, with the joints filled with melted pitch.

The recent decision rendered by our Court of Appeals in the North avenue paving case, has put a stop to all general street paving operations, and as the question of "who is to pay" for improvements hereafter, and under what system it shall be done, will be before us for settlement, it is well to look into the proper material for paving our highways, the cost of the various materials now offered and the particular mode of laying the same from the engineers', the sanitarians' and the taxpayers' stand-points.

I would commend to our tax-payers the very excellent recommendations of his Honor Robert C. Davidson, mayor, made to the Councils on September 21st last.

He suggested the appointment of five intelligent and disinterested citizens, who are to form a board or commission—unpaid—and to have general charge of the paving and repaving of our streets, designating those, if any, that are to be paved out of the general fund for paving streets, etc., etc.

The other points in this message are also of especial value, and our association should use its influence in having them carried into effect. The whole question of improved streets was never so prominently before the public as at this time, and as a citizen interested in all public improvements, and as a taxpayer, I wish to see the question of paving material, etc., settled, before the General Assembly enacts the needed legislation, to enable the mayor and city council to adopt a general, equitable and intelligent ordinance, to give us improved streets of the best character and material and at the lowest cost practicable.

In doing this, if the proper material and mode of paving be adopted, heavy burdens will not be imposed upon the property holders now, nor will the tax rate be increased by providing for the systematic liquidation of a large paving loan, but provision be made for the next generation to bear a portion of the burden.

As Baltimore is many years behind other cities of her size and importance in street paving, we want these improvements made without unnecessary delay.

Having devoted much time and study to material for street paving for several years past, and having examined the material used and the mode of paving adopted in other cities in the north, east and west, I feel justified in recommending vitrified brick as the best paving material for our city, all things considered.

During my recent term of service in the first branch of the city council, I endeavored to have incorporated into the ordinance to repave McCulloh street, a clause authorizing the use of "other improved paving material," so that the ordinance should not stipulate expressly—as originally drawn—that compressed asphalt blocks only, should be used.

I was not successful in this, however, nor was I successful in having the ordinances to repave St. Paul and Calvert streets so amended.

The vitrified bricks are made in Maryland, the adjoining states, and may be made in our city, or at any point where the proper kind of clay is found and any one is at liberty to purchase and lay them. Not being a monopoly, therefore, but open to competition in price, for preparing the street and laying them, there was no lobby to urge their use, at any price their proprietors chose to ask.

His Honor Mayor Davidson, for other reasons, very properly and wisely vetoed these paving ordinances, and the matter of paving these streets was held and still remains in abeyance.

I called the attention of several of the residents of St. Paul and Calvert streets to the brick pavement, and our enterprising fellow-citizen, Theodore Hooper, Esq., who had seen this pavement in Belgium the year previous, interested several of his neighbors in the project, and they have, at their own expense, had a vitrified brick pavement laid for one block on Biddle street, at the intersection of Calvert, while an additional block is now being laid, extending north to Preston street.

I am informed that the property holders in the adjoining block on Calvert street, south of Biddle, and extending to Chase, will contract shortly for this pavement, they paying all the expenses for laying it.

The total cost of the brick pavement to them is $1.80 per square yard. The cost of the asphalt blocks, as laid by the Maryland Pavement Company is, or has been, $2.50 per square yard, while the Belgian block pavement costs from $2.60 to $2.75 per square yard. I understand the last job of laying a Belgian pavement by the city by contract, cost $2.60 per square yard.

As the city does most of the Belgian block paving by day work it is difficult to arrive at the cost of it per square yard, if it can be ascertained at all.

It must be admitted that the granite or Belgian block pavement, as compared with other material, offers the greatest resistance to heavy street traffic; this is the only advantage that can be claim d for its use, over vitrified brick, while I think it can be shown that the other advantages of the brick pavement more than counterbalance the probable greater wearing quality of the granite.

In the western and some of the northwestern states a granite roadway costs about double one of brick. Granite must be brought from considerable distance, while suitable brick clay is found in nearly all the states.

The cost of a Belgian pavement here may be set down then at from $2.50 to $2.75 per square yard. The work done by the city probably costs the latter sum and possibly more.

Although the Belgian pavement is a vast improvement over cobble stone (or properly speaking rubble stone) yet it can not compare in smoothness and comfort to the asphalt or bricks, and unless the joints are laid with pitch, to make it watertight—which entails an additional expense, the leakage into the ground of liquid filth is only a little less than in our present rough stone pavements.

The uneven surface—even slightly uneven—affords lodgment for solid filth and dust, and this kind of pavement is never clean; a rough or uneven street is in the very nature of things, an unclean street.

Another feature, and most objectionable of all, is that the blocks invariably wear extremely and dangerously smooth; that is, slippery.

The pavements on Baltimore or other streets—(outside of the railroad tracks)—are so smooth as to make driving thereon dangerous, while any one who does much driving between the rails should take out an accident policy for both man and beast before venturing upon so hazardous an experiment. The bed of Madison avenue, as well as of Eutaw, Charles and Light streets, outside of the railway tracks is perilously smooth, as is the pavement on Charles street, between Centre and Monument, where there is comparatively but little travel and no railway tracks.

Asphalt blocks present a beautiful smooth pavement, delightful for driving, cleaned by every rain and easily kept clean, non-absorbent, water-tight, preventing the leakage through the ground of surface water and filth, and it is, in addition, noiseless. The cost of this pavement is nearly equal to that of Belgian blocks, while it offers much less resistance to travel than bricks, and hence can only be used for the residence portions of our city.

In cities in which asphalt has been extensively used, its "life" is set down at about six years.

A number of property-holders on Wabash avenue, Chicago, re-

cently invoked the aid of the courts to prevent the city authorities from laying asphalt pavements. The burning of soft or bituminous coal charges the air with sulphuric acid fumes; this dissolves the fine grains of carbonate of lime and leaves its bitumen to be blown away by the wind. When the disintegration once commences, it continues very rapidly.

A recent writer, referring to sheet asphalt pavements, says: "Residents of Washington, D. C., who live in streets paved with asphalt, find the reflected heat from the surface almost unendurable. The intense heat radiated from asphalt paved streets is one of the principal causes of sun-stroke in Washington."

The chief objection to this material, however, is that it wears to a perfectly smooth surface, even more objectionable than Belgian blocks in this respect.

A section of this pavement on Madison street west of Howard, not a business thoroughfare, has been lately repaired by order of the councils, after having been laid for a few years comparatively. Sections of this pavement on South street and on North Charles street have required frequent repairing or renewing, so that it can not be considered a durable pavement, except under a light traffic.

The vitrified brick pavement is as smooth and noiseless as the asphalt blocks and as pleasant to drive or walk upon. As to the matter of wear, while it is especially recommended for the residence portions of our city, yet it has been subjected to the most severe tests in other localities. In Holland and Belgium where stone for street paving is not generally found, vitrified bricks have been used for over a century.

Bricks have been made in Staffordshire, England, for half a century and used in London for paving approaches to freight depots, etc., where the traffic of vehicles is exceptionally heavy.

The first laid in this country was in Bloomington, Illinois, eighteen years ago, and has required no repairs since. It was laid in the same year upon several streets in Pittsburgh, and I am informed is subjected to as heavy traffic as we have in this city, not excepting Pratt street, and is still in good condition; the same may be said of its use in Allegheny City, Johnstown, Wheeling, Columbus and other cities.

The freight depot, yards and approaches of the Chicago, Burlington and Quincy Railroad in Chicago, are laid with these bricks and it is needless to say that there is no heavier street traffic in any other locality in that city. It was laid eighteen months ago, Belgian blocks and asphalt having been taken up to make way for the bricks. The grade is quite heavy.

In Columbus, Ohio, the yards, freight depots and approaches of the Baltimore and Ohio Railroad are paved with the same material.

Two hundred and seventy cities and towns in this country have used or are about adopting this material.

Philadelphia has twenty-six miles of this pavement, while it is also used in Germantown, Harrisburg, Lancaster, York, Pa.; also in Buffalo, Troy and other cities of New York, and many southern and southwestern cities and towns have adopted it. This pavement does not wear smooth or slippery by use. In this respect it is superior to either granite or asphalt blocks. The bricks are as non-absorbent as either granite or asphalt, and hence are not affected by frost, and even when laid with fine sand, they make a water-tight and consequently a sanitary roadway.

Being perfectly uniform on the surface, there is no lodgment for filth or dust and the streets need no sprinkling.

Large sums are expended every year by business men and others for sprinkling our streets, whereas if we had smooth pavements this outlay would be saved.

Dr. James E. Reeves, the eminent sanitarian, late president of the American Public Health Association, says:

"From a sanitary point of view, vitrified brick for roadway paving is absolutely priceless. No other material in use for street paving can be compared with it for cleanliness. Besides, it is the easiest to keep clean and in good repair. Clay is the ore of aluminum, and when properly mixed and vitrified becomes an igneous rock, unaffected by heat, water or frost. It has a greater resisting power against shock than granite, is homogeneous, slightly elastic, has no grit which will bite steel or iron, will neither act upon or be acted upon by horses' shoes, has a more perfect bearing than stone, can be laid more compact, is noiseless, dustless, non-absorbent, and therefore more healthful."

Drs. J. Collins Warren and H. J. Barnes, distinguished physicians and sanitarians of Boston, say that many malignant diseases arise from street dirt or dust, and that the question of paving material is a question of public sanitation, and should be settled by the municipal authorities.

Tests made of brick manufactured at Bucyrus, Ohio, show that they absorbed two and three-eighths ounces of water during an immersion of twenty-four hours, while tests of other bricks showed less power of absorption than many of the hard sandstones used in the north and west for paving blocks in the absence of granite.

Tests made at Omaha, Neb., showed that these bricks would withstand a pressure of 12,000 pounds to the square inch, and for the whole brick of 130,000 pounds. The next important item is the cost. I have stated that the cost of these bricks now being laid in our city is $1.80 per square yard. I am assured that if *our* brick makers would turn their attention to this kind of bricks, they can be laid at about $1.40 per square yard, or about one-half the cost of Belgian blocks, taking the bricks at the price at the kiln, and saving the freight now paid on them—the freight on the bricks now being laid here being about equal to the cost of the brick at the shipping point.

As a matter of political economy, our brickmakers, as well as our taxpayers, should endeavor to adopt a paving material found and manufactured within our city limits, instead of sending tens of thousands of dollars out of the state annually to pay for Belgian blocks, while in the case of the Lake Trinidad or other asphalt pavements, the money goes out of the country to enrich English capitalists who own this material.

In many localities in the valley of the Ohio river, the bricks being of local manufacture, the cost of grading the streets, preparing the road-bed and laying the brick complete is from $1.05 to $1.25 per square yard. In laying out new streets in the western cities, where no gravel or sand is found in the soil, a foundation of broken stone, cinders, sand, etc., has to be provided. This makes the cost 1.45, as at Decatur, Ill., where ten miles have just been laid. At Steubenville, Ohio, the bricks cost $10 per thousand at the kiln, and the total cost of the roadway is $1.25 per square yard. At Franklin, Pa., the cost is reported to be $1.50, including the curbing.

Thus it will be seen that the brick is by far the cheapest material that is being used, while it possesses all the advantages o asphalt blocks, without the very objectionable feature of wearing smooth and slippery, and is far cheaper and far more durable. It is readily and quickly laid, and a section can be taken up, when necessary, and relaid, as easily as can be done with asphalt blocks or any other material.

I understand there is an ordinance (in some of the German cities) that provides for six months official notice to gas or water companies, or any other interests, of the intention to lay an improved pavement. When the time expires, the pavement is laid, and it can not then be disturbed for five years, under a heavy penalty. I think some such regulation would be a valuable one for our city. Looking at a pavement of this kind from a sanitary point of view, I would recommend that our alleys be paved with it and be made watertight, the cheaper quality of brick being used, which would make a cheap pavement, and while our front doors would be well swept and clean, our back doors would not become a dumping ground for offal and filth, a prolific source of disease in a city.

Sanitarians and health officers are now turning their attention to the condition of our alleys, which for some unexplained reason have been overlooked, while they have been busily engaged in cleaning and purifying the streets in front of our residences. Chicago and other progressive western cities are about adopting the system prevailing in Berlin and Paris, of laying a conduit under the sidewalk, into which water and gas pipes, electric and telephone

wires, etc., may be placed, so that the roadway will not be disturbed, when once properly laid.

The water, gas or other pipes or wires could be laid in our alleys, if they are constructed under the provision of an ordinance introduced a few years since by our friend, Mr. Bankard, providing for alleys not less than twenty feet in width in all cases. Some of our alleys are so narrow it would not be possible to construct a sub-way within their limits.

I find there is a general absence of knowledge of what a vitrified brick is. The ordinary fire-brick, made of light-colored clay, is totally unfit for use as a paving brick. The fire-brick is made from refractory clay, while shale clays, so-called, are used for "pavers," the commercial term for these bricks.

Bricks for paving must combine toughness with vitrifaction. If a brick is thoroughly vitrified, it means the whole body of clay melted homogeneously into one mass. Toughness means the tempering which is given to the clay while in the firing or burning process, whereby the life grain and tenacity of the clay are not destroyed. There are many clays that will burn to a condition of vitrifaction, yet will not make a standard paving brick, because they lack the element of toughness.

Clay that will make terra cotta pipe, will, as a general thing, make vitrified brick. Pure clay will not vitrify, but the iron forming a flux unites with the silica, which is the vitrifying process.

An analysis of shale clay from Ohio shows: Sixty-six per cent. of silica, nineteen per cent. of alumina, six per cent. of iron oxide, etc. This is a splendid paving brick clay.

The shale clay may be mixed with potter's clay, or with red clay containing iron. When properly burned, the bricks will vitrify and become as hard as flint. A clay must be free from lime, which may be shown by a test with acid.

The mayor of Steubenville, Ohio, says, they lay six inches of broken stone and then roll the bed with a twenty-ton roller; they next lay six inches of sand, and the bricks upon this, rolling with a light roller—five tons—to make the surface uniform; the bricks are then covered with fine sand, rolled in with a light roller.

In an old street the existing gravel and sand foundation makes a good bed for the bricks, but in the alluvial soil of the western cities, in making new streets, the foundation is an expensive part of the operation. In some localities, where expense is not an object, a deep foundation of steam crushed stone is laid, then six inches of sand or railroad cinders, upon which they lay the common red clay building bricks, laid flat. Upon this an inch of sand is laid, and in turn the vitrified brick, laid upon edge, with melted pitch or thin cement poured into the joints, making the pavement watertight, while the sand between the layers of bricks gives an elasticity that is not otherwise attainable upon a stone foundation. Melted pitch may be poured over the whole surface of the pavement and sand or gravel spread upon it while hot. This makes a roadway similar to rolled gravel, and this covering may be renewed at a slight expense when worn off.

Brick fit so closely together that there are no inter-spaces to retain filth and breed disease. Bricks are adapted for streets over which pass the heaviest traffic. The first cost of a brick pavement is less than any other fairly durable pavement. Brick paving costs less than granite or asphalt, is freer from dust and cheaper to repair. Finally, a brick pavement never wears slippery, as granite and sheet or compressed asphalt blocks do.

STREET GRADING IN OLYMPIA, WASH.

MR. Millard Lemon, city engineer of Olympia, Wash., submitted his annual report to the city council on December 22nd, the first ever filed there. It showed that during the last year 50,907 feet of streets were graded at a cost of $95,381.85 or $1.87½ per lineal foot. On the subject of street grading he said:- "Often, streets graded and not graveled are impassable mud throughout the winter, and I am firmly of the opinion that no street should be graded and left in that state. I can see no objection to including under the contract everything necessary to a finished street—grading, graveling, curbing and in some instances sidewalks—and when properly done (and it should not be received otherwise) an assessment including all expense will have the merit of being for a completed work." He urges the construction of a new sewerage system during this year but advises the council to procure opinions from sanitary engineers on a plan prepared by Engineer Camp before proceeding with the work of construction.

THE HISTORY OF BRICK MANUFACTURE.

By S. K. Fletcher.

IN the most curious of all private tombs at Thebes in Upper Egypt is a complete pictorial description of the whole process of brick-making among the Egyptians. This brick-making lacks the last stage, as brick-makers in America understand it, for the Egyptians for two reasons did not fire or burn many of their bricks. First, the slimy, tenacious mud formed by the deposits of the Nile at its annual inundations, together with the hot sun, gave a cohesive material which, when mixed, or unmixed with straw, and baked with the natural heat in that warm climate, made a brick which would last for centuries in that comparatively rainless region. The second reason for leaving the bricks unbaked is that fuel was in ancient times, as it is to day, the great want in Egypt. The common fuel for cooking, constantly used by the people in towns, villages and country, is nothing else than dried dung of camels, oxen and of the water ox, more commonly known as the East Indian Buffalo. It was not only brick that was left unburned, but the ordinary jars for holding water, and the drinking vessels in general use were made of sun baked and sun dried clay.

We are left in no uncertainty as to the Egyptian manner of making their crude brick, for in the tomb of one Rekmara, found at Thebes, among many paintings representing trades such as rope-makers, carpenters, cabinet-makers, stone-cutters, there is a picture representing the whole process of brick making. This tomb is of the date Thotmes III, who was, with perhaps, one exception, the most famous king of Egypt, who reigned for nearly fifty years, counting from a little before, or about 1500 B. C. In this picture referred to, men are represented bearing on their shoulders the clay in conical shaped baskets, such as are to this day used by the modern Egyptians. This clay was thrown into a heap and the slaves were made to temper it with their feet. The clay when thus worked into the proper condition was cut or taken out by an instrument like the Egyptian agricultural hoe (which seems to modern eyes like a cross between a pick and a wide adz), and then it was placed in a simple wooden mold which made a brick twice the size of the common American brick.

Brick-making was doubtless a huge trust in Egypt. All dwelling-houses were made with sun-dried brick, as also were the garden and temple enclosures, walls of isolated forts, and, indeed, of every kind of edifice except the temples, which were invariably of stone. In short, so great was the demand for brick in Egypt that the government undertook to supply that demand at a moderate price, and prevented all unauthorized persons from entering into the manufacture. The king himself was at the head of the trust, and to insure that nobody else was in the business, his stamp or large seal, was stamped on to the whole length of the brick as soon as it left the mold. That stamp was not a part of the mold. But all the bricks did not bear the impression of the king's stamp. There were persons privileged or authorized by the monarch to make brick, for which, no doubt, a royalty was paid. Among the names impressed upon the brick, those of priests appear the most frequently after that of the king, and showing that this class ranked next to the royal potentate, and that they had no objection to earn an honest penny in the greatest business, after the grain interest, in which an Egyptian could engage. More bricks bear the name of old Thotmes, or Thotmes III than that of any other king. He was in everything a very energetic monarch who lived 1,500 (or more) B. C., or more than two centuries before the Israelites were made to manufacture brick under such hard conditions by Rameses II, the Pharaoh spoken of in the first and second chapters of Exodus. Thotmes III was a mighty warrior and carried his conquests far into Asia Minor, and took many thousand captives, who, as slaves had to conduce to the prosperity of the Royal Egyptian Brick Trust, unlimited. History tells us that this old head of the trust reigned fifty years, and that the country was exceedingly flourishing, and there was a building boom during the whole of his reign.

Among the Egyptian pictures referred to there are some which do not represent brick as adobes, mere sun-dried brick, but the color is unmistakably that of brick which have been burned. There

is not, however, any representation of the process of burning; in short, no painting of a brick kiln. But this portrayal in these Egyptian pictures of brick that has been burned and has met with confirmation in the discovery of burned brick, which the ancient Egyptians used for under-water purposes, or where the building material was exposed to great dampness.

It is, then, in Egypt that we have the earliest authentic particular records and facts concerning our most honorable and ancient vocation of brick-making; but it is also true that in the Bible we have a general statement that brick were made much earlier, and that was at the tower of Babel, which would take us back about eight or ten centuries before old Thotmes III's days. For about 2,250 years B. C., according to some chroniclers, and 3,000 according to others, the tower of Babel was begun; and, in the 11th chapter of Genesis, 27th verse, you will find it thus written: "And they said one to another, go to, let us make brick and burn them thoroughly. And they had brick for stone, and slime for mortar." In the original Hebrew, a sectional gentleman informs me that where in the Egyptian version is rendered, "burn them thoroughly," if translated literally it would read thus, "burn them to a burning." So there is no mistake here about the post-diluvians burning brick. If the post-diluvians knew all about it, why of course they must have derived their knowledge from Noah and his sons, who were ante-diluvians, and it is therefore reasonable to claim that our profession is as old as that of the musical instrument makers, and the musicians, and that of the workers in copper and iron, as Jubal and Tubal-cain, who are only the sixth generation from Cain the first son of Adam and Eve. Indeed, if it comes to antiquity, may we not go back a little further, and claim that, by inference, brick manufacture was indulged in by Cain himself while Adam was still alive? For are we not told in Genesis, 4th chapter, 17th verse, that Cain was so glad that he had begotten a man-child, that he "turned in and builded a city and called the name of the city after his son Enoch?" Now we assume that no man could build a city, especially in the land of Nod, without using brick, and it is probable that Nod was a country in the same Euphrates valley where they began the tower of Babel; it is altogether reasonable that Cain did not use adobes, but regular burned brick, which implies a brick kiln. So you see, my fellow-craftsmen, that we can, with a good show and reason, trace our craft back to a time coeval with Adam himself.

But to return to history where we do not need theories and inferences. The discoveries in these later days of the ruins of Nineveh by M. Batta, the French consul at Mosul, and the excavations and researches there by Messrs. Layard and Rawlinson, have thrown much light on the usage of brick for building at a very remote period in the capital of the ancient and great empire of Assyria in the valley of the Euphrates. The building material of Babylon, the older and the great rival city of Nineveh, was mostly of adobes or sun-dried bricks, for which the wide and often overflowed plains of the Euphrates offered as good slimy clay as Egypt itself. But Nineveh, situated on a plain in the upper valley of the Tigris, and almost under the Mountains of Koordistan, and consequently exposed to more plentiful rains than Babylon, the building material used were stone and burned brick. And though so many centuries (nearly 800 years B. C.) have elapsed after its overthrow by the Medes, and after 625 B. C., the time of its total destruction, yet it was found by Mr. Layard that the seemingly imperishable stone of the mountains were either corroded by time or disintegrated by fire, while the brick were as firm as ever. This led Mr. Layard to make the general and true deduction that as building material nothing has ever been invented by man which equals brick in enduring quality. Moreover, the most important historical discoveries have been made in the last half century at Nineveh and Babylon, because the inhabitants of these ancient cities committed their history not to records on papyrus or parchment, or bronze or stone, but to burned brick cylinders. The stone would have partially perished, the parchments, if known at that time would have decayed, and the papyrus, having not the dry climate of Egypt to preserve it, would have been reduced to dust to damp mold. But the brick cylinders, covered with their wedge-shaped characters, are to this day preserved intact, and even the Museums of Great Britain, France and Germany, show by the thousands these brick records of Assyrian ancient history, of Assyrian daily life, and also the very catalogues of Assyrian libraries.

We often hear at banquets, toasts to the printers' profession "as the art preservative of arts," yet here in Nineveh, at a period probably more than 3,500 years before Faust and Guttenberg made a single metal type from which they printed off the celebrated Meutz Bible (about 1450 A. D.), and certainly 2,000 years before the Chinese began to print books from engraved blocks of wood (about 50 B. C.), the real art preservative of all arts.

The Bible is admitted by all archæologists to be the oldest of books, but as it was not written so much to tell how people lived as how they ought to live, we have only incidentally the manners and customs of life, the instruments and implements with which they worked, the materials for building their cities, etc. Notwithstanding all this we can learn a good deal incidentally of the manner of life of the Jews and of the surrounding nations. Thus we learn of the brick-making in Egypt, which is confirmed by the pictures on the Egyptian walls which date hundreds of years before the Children of Israel left Egypt under Moses. In like manner we learn of the brick kilns of Nineveh. In the whole Bible there are but three mentions of brick kilns, and one of them refers to the brick kilns of Nineveh, namely that in the prophecy of Nahum which was made, according to the best chroniclers, in the Eighth century B. C. (Nahum III, 14th), "fortify thy strongholds; go into clay, and tread mortar; make strong the brick kilns." The second mention of the brick kilns is in the 43d chapter of Jeremiah and 9th verse. Some think that in this case the word translated brick kiln should be brick work. But the first usage in the Bible of the word brick kiln is in 11th Samuel, 12th chapter and 31st verse, where it tells of David's siege and conquest of the city of Rabbah, the capital of the Ammonites, and how he "put through" his enemies taken in the conquered city. Suffice it to say that one of these punishments meted out to the enemy is thus described: "And (he) made them to pass through the brick kilns." Pretty severe punishment that, when we take into consideration the degree of heat required to make a good first-class brick. The new revised version of the Scriptures gives a marginal rendering a little different in order to soften the hardness of the punishment, and this explanatory note is added, viz: "with a slight change in the Hebrew, 'he made them labor at the brick kiln.'" But in whatever way it is rendered, we have the important fact that brick kilns were known in the country adjoining Palestine in the time of David, and David lived about the period when Troy was being besieged by the Greeks, *i. e.*, about the eleventh century B. C.

The reason that there are few allusions to brick and brick making in Palestine proper is that the Holy Land abounds in the best of building stone of various kinds, and they had no great need of brick.

To come to the making and using of bricks by the Greeks and Romans, we come down to comparatively modern times. For the Olympic games were revised by Iphitus 776 years B. C., and it is from that year that the Greeks counted their period of time—their calendar,—while Rome had its fabled foundation by Romulus 23 years later, or 753 B. C. Consequently these two periods of time are many centuries after brick were molded and burned at Nineveh, and about 800 years or more after old Thotmes III put his royal stamp upon bricks in Egypt. It has been supposed that the Greeks did not employ bricks until after their subjugation by the Romans (*i. e.*, in the year 146 B. C.), but this is a mistake, for Vitruvius, the famous Roman architect, who flourished in the first centuries of the Christian era, gives an account of the ancient walls of Athens (that is ancient by several centuries in Vitruvius' time). He mentions particularly the important Athenian walls, or fortifications towards Mounts Hymethus and Pentelians; and also the Cella, or sanctuary rooms, in the temples of Jupiter and Hercules, which were constructed long before the Christian era. The Greek name for a brick was derived from δῦρον (door-on), a

hand-breadth. They called their various sizes of bricks, respectively, didoron (a foot and a half long and six inches wide and much thinner than modern brick), tetradon (three feet long and a foot wide), while the pentadoron was 42 inches long and 18 inches wide. Bricks were also made just half the size of these to break the joints of the work. The Greeks laid the long bricks in one course and the short bricks in the course above them. Vitruvius says the longest brick (that measuring 42x18) was used in the public buildings at Athens, while the tetradoron was used for private buildings and dwellings.

The Romans, according to Pliny the Elder, did not make much use of brick until about two centuries B. C. Then the material for building was extensively used. Just before the Christian era scarcely a building was constructed of stone except the temples and even the inner walls of these were constructed of brick. In the days of Julius Cæsar (who died suddenly in the year 44 B. C.) there was a regular boom in brick buildings, but it was the boast of his successor, Augustus, that he "found Rome built of brick, but left it marble." This, however, was rather an empty boast of Augustus or his flatterers, for, during his reign, there was a perfect mania for building, and ten times as many brick were made and burned as before, because, in almost every case, the walls of the magnificent palatial buildings—even the great palace built by Augustus himself on the Palatine Hill (hence the origin of the word palace) was, as far as the walls were concerned, altogether built of brick, and then were plated or veneered with marble. The Pantheon, which was built B. C. 261, only three years after Augustus was declared emperor, remains intact so far as its brick work is concerned. Being consecrated as a church, this edifice is, of all the buildings in Rome, the most ancient by a century, being more than one hundred years older than the Coliseum. It was, in the middle ages, stripped of its marble plating, except in a few instances, but the perfection of the brick work exacts the admiration of every architect, artist, and last, but not least, of every brick manufacturer. The bricks are of various sizes, like those of Athens.

The dimensions of Roman brick vary, being 7½ inches square and 1½ inches thick; 16½ inches square and 2¾ inches thick; and 1 foot 10 inches square and 2¾ inches thick. Besides this they had many brick in parallelogram form about the size of our ordinary brick in length and breadth, but in such case never thicker than 1½ inches. They also used larger dimensions in parallelogram, but with the same proportionable thickness mentioned in the square bricks above. In a famous modern encyclopedia the writer speaks of the Roman bricks in many cases showing signs of decay, while the mortar (Roman cement), remains entire. This is a mistake. A gentleman who resided seventeen years in Italy, and who was consulted in regard to this very thing, says the writer in this encyclopedia is entirely mistaken, but, doubtless, got his impression from the Amphitheater of Puteoli, or Pozzuoli (7 miles from Naples), a building whose major axis of the ellipse is 480 feet, and the minor axis is 382 feet. This amphitheater was built 27 B. C. The greater part of this structure is brick, and any one may easily calculate that it required an enormous quantity of the article. As this amphitheater was also for naumachia, or sea fights, the arena was supported in a most ingenious way by lofty and thick brick arches in the substructure, so that when all was flooded they could sustain the tremendous weight of the millions of tons of water above. Now, although this under-ground, and for every time a naval performance took place under water, portion of the amphitheater was in constant use for about 500 years, not a brick has shown the least sign of decay. But in the above ground portion of this amphitheater, many pieces of *tufa* (a soft volcanic stone), hewn into the shape of bricks to face the rubble of hard stone used between the outer coping and outside portions of brick work on the walls. They were probably cheaper than brick and were never intended to be seen for they were plastered over. In course of time the plaster fell from the exposed walls and in every place this soft tufa was thus opened and exposed to the full force of rains and dampness, the soft stone, always on the front of hard stone rubble work, crumbled away, and the Roman cement and the outside brick on the corners and above (which looks like frame work) are untouched by decay.

In modern Italy the bricks are made as thin as the old Roman brick because they require less fuel, and at the same time they obtain a harder article.

It is said that no remains of ancient brick kilns have been discovered either in Greece or throughout Italy. The reason being that kilns were only temporary structures, like the old fashioned kilns in our own country and England, and therefore were easily effaced.

The city of Pompeii contained about 25,000 inhabitants, and this old Roman City, not far from modern Naples, was overwhelmed by pumice stone and ashes in the year 79 of the Christian era. As no lava touched the devoted city, and only covered over the lower stories of the houses (which, however, were destroyed by time, and by men just after the year 79 A. D. taking the material of the upper stories for rebuilding further away from the old site), we have the lower stories in very perfect preservation. The fronts of the houses, with few exceptions, were brick either plated with marble or covered with stucco. All the others, *i. e.*, the back walls, were of rubble work. The city of Pompeii was partially destroyed by an earthquake in the year 63 A. D., and was then rebuilt in the 16 years which lapsed between the years 63 and 79 A. D. This then gives us a sure date for the new buildings. And although the whole city had been buried for 1,800 years, yet the brick work, where not crushed by superincumbent weight is as perfect as if laid ten years ago. No brick kilns were found in the city or near it, but doubtless the Greeks, Romans, and the people of Nineveh made their kilns and run them on the same principle as the modern Chinese kilns, which are identical with those used in China for more than 2,000 years, *i. e.*, the ancient kilns were like those used in America fifty years ago, and are still used in the out-of-the-way-places.

From D. W. M. Thompson's work, entitled "The Land and The Book": The first volume has the sub-title of Southern Palestine. Beginning on page 163 of this book, issued by Harper Bros., 1880, we find some very interesting notes on brick and brick-making, by Dr. Thompson, who resided fifty years in Syria, and traveled extensively, and many times through the Holy Land, Egypt, Northern Arabia, and other lands of the East. He says: "I have carefully examined the business of brick-making in its minutest details—in Cyprus, at Antioch, at Hamuth, and throughout Syria and Palestine. In all these oriental regions a considerable amount of chaff is tramped with the feet into the mortar (for making crude brick). In Egypt, however, the quantity used is much less, owing, I suppose, to the tenacious property of the Nile mud. I inspected the bricks of numberless ancient buildings in the valley of the Nile—pyramids, fortifications, houses, garden walls, and the like—and could not understand how the withholding of almost an infinitesimal amount of 'tibu' (chaff, straw or stubble) by Pharaoh could have proved such an intolerable aggravation of the hard service demanded of the Hebrew; nor why they should be scattered abroad throughout all Egypt to gather stubble. This coarse, hard stubble is never intermingled with the mortar, either in ancient or modern brick that I have seen in Egypt, and is quite unfit for such a purpose (only a little very fine chaff was and is used). It seemed to me then, and subsequent observations have tended to confirm the impression, that the coarse hair stubble collected throughout all Egypt must have been mainly intended to feed the fires that baked a part of their tile and bricks (there were plenty of burned brick in Egypt); but I know that it is asserted that all burned brick found in Egypt is of Roman time, but I am not prepared to admit this. The burning of brick must have been known in Egypt, and also the superiority for many purposes of such brick over those merely dried in the sun. Not to mention the bricks manufactured in the valley of the Euphrates, we read of brick kilns in this country (Palestine) in the time of David, and Jeremiah was commanded by the Lord to hide great stones in the brick kilns which is at the entry of Pharaoh's house in Tahpanhes (in Egypt). This was centuries before the Romans had anything to do with

Egypt. The point to be made is this: There were brick kilns in Egypt at an early date. What kind of fuel was employed in burning their brick is now not known. If it was their kush (coarse straw and stubble with the roots), the amount consumed would be enormous. While ascending the Nile I frequently saw large mounds of straw floated down the river on boat rafts, and upon inquiry, was assured that the greater part of it was to feed the furnaces of the Khedive's various manufacturing establishments. Subsequently I examined these furnaces, and although I did not see any brick kilns, I did see kilns for burning lime, and at one of them I saw a long train of camels bringing fuel to it. The loads were made up of stubble gathered from corn fields, and from the cotton, sugar and rice plantations, and from any and every place that stubble could be collected. It was called kesh by those poor workmen, and that was the very word used by the Hebrews on the banks of that same river to specify the stubble which they had to gather throughout all the land of Egypt, just as these slaves of the Khedive—the modern Pharaoh—had to gather fuel. I went into the vaulted room where the men fed the fires, and found it hot to suffocation, and was compelled to escape immediately. None but a naked Egyptian could endure such heat. Now if the Hebrews were obliged to furnish only a small part of their daily task in baked bricks, we can at once see the intolerable addition to their hard service if they were compelled to go through the land gathering this amount of stubble wherever they could find it. I venture, therefore, to raise the inquiry whether such may not have been the case, and also the cause of their aggravated misery."

AN ENGINEER'S ADVICE REGARDING CITY IMPROVEMENTS.

MR. WILLIAM STEYH, the city engineer of Burlington, Iowa, by special invitation addressed the Commercial Club of that city on December 23d, on needed public improvements. His remarks apply with equal force to other cities like Burlington. In the course of his address, Mr. Steyh said: "Among the various improvements most necessary to a well regulated community, none are more important than an abundant supply of pure water, adequate sewerage facilities, and well paved and cleanly kept streets.

"On November 8, 1880, an ordinance, providing for the construction of sewers in the city of Burlington, was duly adopted by the city council, and various sewers have been built since that time, mostly along the natural drainage channels in the lower part of the city, leaving the residence portion, with a very small exception, without sewerage facilities.

"Although eleven years have passed since the sewerage system was established, only a little over four miles of sewers have been built, which is certainly not in keeping with one of the largest and most prosperous cities in the state of Iowa.

"There are many reasons for this unsatisfactory state of affairs, of which the following are the most prominent: First, the necessity of building unusually large sewers to provide for an extension and rapid surface drainage, which required nearly all the funds realized from a yearly levy of two mills on the dollar, leaving scarcely any means with which to extend the system into the residence portion.

"Second, the difficulty to distribute the cost equally against the abutting property, and give equal facilities to all, which is an utter impossibility in a city situated like Burlington, where in many cases the property on the lower side of a street can not utilize the sewer, and yet it is obliged to contribute towards its construction, giving cause for a seemingly just complaint.

"Third, whenever the city authorities attempted to order sewers constructed with a view to reach some thickly populated district, an avalanche of remonstrances from the interested property owners was the usual result, and consequently the sewer project was dropped by the city council without much acrimony.

"It is interesting and even amusing to hear the reasons assigned by some of the remonstrators for their opposition to the construction of a proposed sewer. Some of those who have built cesspools will claim to have ample facilities for the disposal of sewage; others that the sewer is not needed by anyone and, therefore, it is wrong and unjust to make them pay for it, while some insist that it is a gross injustice to make them pay as much for a small sewer as someone else for a large sewer, and a good many will acknowledge afterward that they signed the remonstrance because somebody told them that their share of the expense would be very heavy, and had they known the true facts in the case, they should not have signed the remonstrance against, but rather a petition for the construction of the proposed sewer.

"To the first mentioned objections I will say some day you will realize the folly of your statement, in regard to the satisfactory disposal of sewage by the aid of a cesspool.

"To the second, sewers are a necessity on sanitary grounds and a share of the burden must be borne by all who are benefited by their construction.

"To the third, you forget the fact that the sewage from the small sewer must pass through the large one and that the use and privileges are alike in either case, and, therefore, the expense should be borne equally.

"To the fourth, never sign any paper until you are thoroughly acquainted with all the facts in the case, and to the honorable board of aldermen, inform yourselves thoroughly on the expediency of all proposed public improvements, and if convinced of their necessity, vote for them unfalteringly and you will earn the gratitude of your erstwhile opponents. As stated above, one of the most serious obstacles to overcome in sewer construction, is to give equal facilities to all who are compelled to pay their share of the expense, as no distinction can be made between the property actually benefited and the property receiving no benefit at all, as long as both properties are adjacent to the sewer and subject to assessment under our sewer ordinance.

"Perhaps the best way to adjust the matter would be to build the entire sewerage system in a district, draining into one main sewer, including also the lateral sewers in the alleys where they are needed, under one contract, and assess a stipulated amount per square foot of surface drained, regardless of size of sewer the excess of the cost of construction of said sewers, over the amount realized from the assessment to be paid out of the general sewer fund. * * *

"The problem with what material, and how to pave the streets, is happily solved, so far as Burlington is concerned, and for this reason I will not weary you with a long discussion on this subject, merely repeating my recommendation to the city council of last spring, to take the necessary steps for getting the needed legislation at the coming session of the legislature, enabling the city to make a yearly levy of four mills on the dollar, instead of the present two mills, for paving purposes, so that the good work of getting the city out of the mud may be carried on more rapidly than has been possible heretofore, for want of funds on the city's part.

"We will now consider the question of how we can keep the paved streets clean, for all of you must admit that a dirty street, no matter how nicely paved, reflects very seriously on the thrift and tidiness of a community, and if we don't want to be called untidy or slovenly, we must devise ways and means of keeping our streets clean.

"On various occasions I have expressed myself in favor of abolishing our present system of the hoe and shovel brigade, making its weekly appearance on the streets in the business portion of the city, and a few spots amongst the residences, as being out of date and very unsatisfactory. Streets should not only be cleaned at stated intervals, but as often as necessary, be this in summer or the middle of winter, as you will readily admit by the present condition of our streets; nor should the property owner or renter be required to attend to this matter, as that duty belongs to the city, but on the other hand the occupant of the store or dwelling should be prohibited from throwing garbage or refuse of any kind on the streets, so that nothing but the natural accumulation of dirt would have to be removed by the city.

"There are various methods by which streets are cleaned in all

civilized countries, which I will not enumerate here, but merely state that the one giving the best satisfaction in this country is by the use of a horse sweeper, and I earnestly hope that our city authorities will not delay this matter much longer, but procure this much needed implement at once.

"Having discussed this question of when and how the streets ought to be cleaned, I will consider the sources from which the means should be derived to defray the necessary expense. It seems but just that the parties who are responsible for dragging and depositing dirt on the paved streets should pay for the removal of same, and for the reason no further argument is necessary to convince all fair-minded people of the truth of this statement. As to the question, who are these parties, I will answer, all those who own horses or mules, and vehicles of various descriptions, from the humble drayman who keeps a horse and dray for hire, to the rich man who keeps horses and carriages for pleasure. Under our present law, the city exacts a license fee from all those who keep horses and vehicles for hire, while all others go free. The injustice of this is so apparent that comment is unnecessary, and no time should be lost to correct this evil. I hear some of my friends, who are the happy possessors of the noble beast, ask, do you intend to exact a license fee from us, in addition to the general tax we have to pay on our possessions, wherein our horses and vehicles are included? To which I will reply, yes, and ask in turn are you not obliged to pay this general tax, whether the streets are paved or not, and do you not save a large amount in wear and tear on vehicles, not to speak of lightening the burden of the dumb brute, nor the comfort derived from a drive over a smooth pavement? I am sure you will answer yes, and agreeing with me in this, it is but fair to presume that you will also agree with me on the team license question.

"An annual license of from three to five dollars per head of horses or mules, according to light or heavy loads, would net from $3,000 to $4,000, which sum would be ample to keep the streets cleaned and make the necessary repairs."

A NEW BRICK AND STEEL PAVING DEVICE.

A NEW device in street paving is the Sheridan block, a patent owned by Belden and Sheridan, of Franklin, Pa. It comprises a combination of steel, brick and sand. Bricks of special and proper hardness and homogeneity are set on edge in blocks of 8x3 ft., bedded in sand on a sheet steel bottom. This block is then bound together by a steel band having a flange passing under the bottom of the block and riveted together. This combination block is then compacted by sand, cement or asphalt. It weighs about 1,000 lbs. and can be set upon any dry earth bottom without any special preparation. The area of these combination blocks obviates the danger of settlement present when single bricks are employed, and their use is claimed to be cheaper than when single brick and curbing are laid down.

ADDITIONAL WATER SUPPLY OF ROCKFORD, ILL.

THE report of the commission on an additional water supply for the city of Rockford, Ill., composed of Messrs. J. T. Fanning, D. C. Dunlap, and D. W. Mead, has been printed, and it makes a pamphlet of about fifty pages, with drawings and statistical tables. It is an ably-prepared report, and presents a thorough examination of the subject. The conclusions that the commissioners reached are that the source of an additional water supply available within reasonable financial limits, are set forth as follows:

(*a*) A multiplication of wells in the Potsdam rock, continuing the present system of wells, which are about 1,500 feet in depth.

(*b*) Drawing an increased supply from the Potsdam rock by a low lift pump.

(*c*) Drawing an additional supply from the St. Peter rock, which overlies the Potsdam, from wells about 325 feet in depth, by a low lift pump.

(*d*) Taking an additional supply from Rock river, without or with clarification.

(*e*) Taking an additional supply from the drift formation by driven or excavated wells located above the limits of the city.

(*f*) Procuring an additional supply by impounding the flow of springs and surface waters.

The cost of reservoir dam, pipe-line and pump pit required for the new system is estimated at $125,000.

PAPERS OF STUDENTS OF ENGINEERING.

THE first number of the second volume of *The Transit*, published semi-annually by the State University of Iowa, is out. It contains a number of well written papers by members of the engineering society of the University, some of which are quite freely illustrated, including the following: "Secondary Strains," Emil A. Wallberg; "Fresh and Salt Water in Cement Mortar," M. I. Powers, Jr.; "Design for a Five-Horse Power Dynamo," F. A. Hastings; "Strength of Railroad Spike and Log Screws in Different Woods," A. J. Cox; "Highway Cantilever Bridge," J. C. Spencer; "The Howe Truss Problem with a Carpenter's Square," Joseph H. Howe; "Testing Cement by a Microscopic Method," Alden H. Brown.

ILLINOIS BRICK-MAKERS.

THE annual meeting of the Illinois Brick and Tile Association will be held at Springfield, Ill., on January 19 and 20, in the Senate chamber of Capitol building. Among the subjects to be discussed are the following: "Burning Paving Brick," H. Dawson, Springfield, Ill.; "Hollow Brick and their Uses," "Shale and its Uses," Joseph Stafford, Springfield, Ill.; "Mismanagement of Yards," William Stare, Mendota, Ill.; "Manufacture of Brick and Tile," C. C. Jenkins, Tolono, Ill.; "Crude Oil as Fuel," N. W. Reid, Jacksonville, Ill.; "Burning by Slack Coal." The President is B. F. Tenney, of Bement, Ill., and the secretary is G. C. Stoll, of Lexington, Ill.

RECENT TESTS OF BRICK.

A RECENT test of brick made by the dry clay process, at Watertown arsenal, showed an average compressive strength of 3,972 lbs. per square inch. In one instance it reached 4,973 lbs. per square inch. The brick used in making the test came from the Chicago Hydraulic Press Brick Co., of Porter, Ind. A test was made at the same place on a "fancy pressed brick" made by the National Brick and Tile Co., of Bradford, Pa. The first crack developed at a pressure of 305,000 lbs. and the brick crushed at 364,300 lbs., or 11,130 lbs. per square inch. This indicates almost as great compressive strength as granite paving blocks, which is from 12,000 to 20,000 lbs. per square inch.

INVESTIGATING PAVING IN DIFFERENT CITIES.

MR. C. R. CUTTER, superintendent of paving in Boston, and Mr. Henry B. Wood, secretary and executive engineer of the street department in the same city, have visited the principal cities of the country for the purpose of gathering new information on street paving. Their investigation will be made the subject of an official report. They were sent out especially to learn the results of experience in using brick pavements, which there is a desire to try more extensively in Boston.

A MEDAL FOR A ROAD ROLLER.

THE Harrisburg Foundry and Machine Works were awarded a gold medal at the Augusta, Ga., Exposition for their steam road-roller. The roller exhibited was purchased by the city of Augusta. The medal was the only one given by the exposition.

GRANITE BLOCK PAVING IN ATLANTA.

CAPTAIN R. M. CLAYTON, city engineer of Atlanta, Ga., has prepared his report for 1891, which shows that during the year seven miles of streets were paved with granite blocks, at a cost of $172,350.68. This is more than was done in any previous year.

REPORT ON THE WILMINGTON, DEL., SEWERAGE SYSTEM

THE directors of the street and sewer department of Wilmington, Del., Messrs. Joseph L. Carpenter, Jr., J. Newlin Gawthrop, and Samuel Chambers, have published their fourth annual report of the work done under their direction, in which they review in detail the improvement of the sewerage system of Wilmington, under the charge of Mr. T. Chalkley Hatton.

TWO new pamphlets, handsomely printed, have just been issued by J. W. Penfield & Son, giving a vast amount of useful information regarding upright stock brick machinery, any of which together with their publication on "Brick Pavements," will be sent without charge to any address.

Improvement and Contracting News.

PAVING.

Salem, Ohio, is paving its streets.

Massillon, Ohio, will improve streets $50,000 worth.

Capitol avenue, at Atlanta, Ga., is to be paved with asphalt.

Oshkosh, Wis., will expend $75,000 next spring for street paving.

The road between Jamaica and Flushing, N. Y., is to be macadamized.

State street, from Michigan avenue to Bond street, Saginaw, Mich., will be paved.

A road convention is to be held at the State House, Trenton, N. J., on January 22, 1892.

The council of Moundsville, Va., passed an order for the opening of Second and Third streets.

Preliminaries are well under way for considerable street paving next summer at Ashtabula, O.

Bonds for improving Lamborn ave., Superior, Wis., to the amount of $42,000 have been sold.

Clark street, between Randolph and Washington streets, Chicago, Ill., will be paved with cedar blocks.

The contract has been let to grade and macadamize Second street, Seattle, Wash., through the Calhoun addition.

The board of public works of Detroit, Mich, will this month make tests of brick to be used in paving next year.

The people of Savannah, Georgia, want the streets improved, and they will sustain the council in improving them.

R. B. Malone & Co. have received the contract for the superstructure and paving of the Oxford street bridge, Philadelphia, Pa.

Hugh Murphy received the contract for paving Sherman avenue, Omaha, Neb,, with Colorado red stone at $1.69 per square yard.

The total increase for street improvements and sewers in Cincinnati, Ohio, during the past year over 1890, is $1,308,-697.

Seven miles of street paving has been laid with granite block at Atlanta, Ga., during the past year, at a total cost of $172-350.68.

A boulevard is to be built from Scranton to Elmhurst, Pa. It will be six miles long, have a roadway forty feet wide, and cost $20,000.

The widening of Main street from the junction of Lebanon and Porter streets to Mt. Vernon street, Melrose, Mass., will soon begin.

The Trustees of Greenbush, N. Y., have voted to issue $39,000 of bonds for the grading, forming and flagging of Third and Partition streets.

Plans for opening Rouville street, between Darling and St. German streets, Hochelaga, Canada, are ready. The street is to be 60 feet wide.

Dexter avenue, Cincinnati, O., will be improved with vitrified brick from Hackberry street to Fairfield avenue as soon as the weather will permit.

The Mayor of Baltimore, Md., has expressed his intention of directing the operations of his administration toward the improvement of the streets.

Fourteen days was the time occupied in paving East Court avenue, Sioux City, Ia., from First to Fourth streets, and in that time about a million brick were laid.

Eleventh street from Market street to Delaware avenue, Wilmington, Del., is paved with vitrified brick, and Jefferson street will be paved with the same material.

At Oakland, Cal., the city council, on Dec. 21, '91, passed an ordinance for $800,-000 bonds for the west Oakland Park and Lake boulevard. The election will be April 21st.

A contract for 200,000 granite paving blocks has been awarded by the Committee on Roads and Bridges, at Cambridge, Mass., to S. and R. J. Lombard at $37.85 per thousand.

A number of the prominent citizens of Cleveland, Ohio, have organized for the purpose of constructing a boulevard system. Charles F. Brush is president of the association.

Charles Stone was awarded a $16,300 contract for grading Wells street, St. Paul, Minn., from Edgerton street to Arcade street. The city engineer's estimate of the work was $15,380.

The road between LaCrosse and Onalaska, Wis., will be macadmized by Leopold Perris at 75½ cents per lineal foot. The road is to be twenty feet wide and twelve inches deep.

It is projected to pave Copely road for a mile and a half west of Akron, Ohio, and a special enactment will be asked of the legislature for a levy of $10,000 upon property in that vicinity.

The Board of Public Works of Kansas City, Mo., has recommended that Fourth street, from Delaware to Wyandotte streets, and Ninth street from Maine to Broadway be paved as business streets.

The contract for grading, curbing and paving Versailles avenue, McKeesport, Pa., was awarded to Keeling, Bridge & Co. The street is to be improved from South Park to Packer street and will cost $7,080.

Arrangements have been made for street grading at Garfield, Wash., on a more extensive scale than was at first intended. Third street will be graded from Second to Fourth, and perhaps even farther west.

The boulevard at Cadillac, Mich., has been built by private subscription. It is about seven miles in length and makes a complete circuit of Little Clam Lake, passing between Little and Big Clam Lakes.

The estimate for grading Twenty-seventh street from Pacific avenue to East K street, Tacoma, Wash., is $35,000. The city engineer has also several cross-section plans for parking and paving the streets.

The common council of Buffalo, N. Y., decided to report in favor of awarding the following paving contracts: Alabama street, stone, John Love, $5,187; Dodge street, asphalt, German Rock Asphalt Paving Company, $14.487; Georgia street, block stone, P. B. McNaughton, $6,900; Hayward street, first-class stone, John Love, $6,157.

Since the council of Trenton, N. J., passed the ordinance for the issuing of $5,000 of Park Bonds, the Park Committee intends to finish one mile of driveway and also complete the new entrance on Parkside avenue.

Seneca street, Buffalo, N. Y., is to be paved with block stone pavement. The contractors promise that the pavement will be such as to cause the citizens to wish that every street in Buffalo was paved with the same material.

Union street, Chattanooga, Tenn., is to be paved with granite from Cowart to Market streets; a distance of 1,500 feet. Wingfield Bros. have the contract and their bid was $2.45 a yard. The entire work will amount to $3,675.

During the past year, seventy-five miles of street paving was laid in Chicago against one hundred and thirteen miles the previous year. It is said that fifty miles more could have been paved last year if the sewers and water pipes had been in place.

A committee on pavement from Winona, Minn., visited Dubuque, Davenport and Burlington, Ia., Aurora and other Illinois cities, investigating different materials used in street improvement, and it seems that brick has made a favorable impression upon many if not all the councilmen.

It has been announced by Superintendent Carter of the street department of Boston, that it is his intention to pave Washington street from Boylston to Adams streets, early this year. The pavement will consist of a concrete foundation, upon which large granite blocks will be laid.

The street committee of New Haven, Conn., has recommended a lay-out for the extension of Myrtle and Market streets; the extension of Third and Fourth streets easterly to the harbor line and westerly to Kimberly avenue, and that Edgerwood avenue be extended to Sherman avenue,

The city council of Jacksonville, Ill., has passed ordinances for paving several streets this year. Among them North Main street is to be paved from the Wabash railroad to the city limits, with a pavement fifteen feet wide on the sides and leaving a space fifteen feet wide in the center for a boulevard.

The hemlock pavement laid on Front street, Toledo, O., by Contractor Dewey, has been accepted. It is a question which is the better for paving, hemlock or pine. The contract for paving the alley between Summit and St. Clair streets, from Adams to Oak, was let to George H. Burdett for $2,001.23.

L. B. Budd has received the contract for paving Cherry street from Fifteenth to Nineteenth streets with gravel for $6,139.14, at Kansas City, Mo. A contract has also been awarded Trestrail and Brosnahan for the paving of Jefferson street from Eleventh to Fourteenth streets with vitrified brick on concrete for $8,391.50.

Youngstown, Ohio, has from six to eight miles of paved streets, and the city commissioners have decided to take action in the direction of keeping them in a cleanly condition. They are considering the advisability of purchasing horse sweepers and awarding the contract to some party to keep the paved streets swept clean.

The board of public works, of Grand Rapids, Mich., has been asked for an estimate for the work of paving South Front street from Pearl to Bridge streets with asphalt, with cedar blocks on a concrete foundation, with vitrified brick and with macadam. They are asked to report to the council as soon as practicable what each will cost, and which in their opinion would be the best.

The repaving of Broadway, New York, following the laying of the cable conduit in that street, has been completed, and in 175 working days, 2 500,000 granite paving-blocks have been laid. The contractor, John D. Crimmins, claims that this is the largest number of blocks laid in the same time on one contract. The city retains 30 per cent. of the contract price until October of 1892, in addition to demanding two securities of $60,000 each for the faithful performance of the work.

The street commissioner of St. Louis, Mo., has instructed the surveyors of his department to prepare estimates for the paving with granite blocks the following streets: Biddle street, from Broadway to Fourteenth street; Car street, from Broadway to Fourteenth street; Wash street, from Third street to Fourteenth street; O'Fallon street, from Broadway to Fourteenth street; Commercial street, from Locust to Morgan street; Dickson street, from Levee to Broadway; O'Fallon street, from Levee to Broadway; Ashley street, from Levee to Third street; Biddle street, from Levee to Third street; Cass avenue, from First street to Broadway; Mullanphy street, from Levee to Broadway; Third street, from Plum street to Chouteau avenue; Lombard street, from Second to Broadway; Cerre street, from Seventh street to Eleventh street; Gratiot street, from Seventh to Tenth street; Sixth street, from Chouteau avenue to Park avenue; Rutger street, from Levee to Ninth street; and Park avenue, from Levee to Third street.

SEWERS.

Iowa City, Ia., is talking of establishing a sewerage system.

A sewer 325 feet long is to be built on E. 46th St., Bayonne, New Jersey.

The aldermen of Springfield, Mass., voted to lay a 200-foot sewer on Bell street.

Ten thousand dollars will be spent on a sewer to be built this year at Dunmore, Pa.

The sum of $85,000 will be spent this year for sewer construction at Meriden, Ct.

The citizens of Irvington, N. J., are agitating the question of a sewerage system.

The plan of sewerage submitted by the city engineer of Emporia, Kan., has been adopted.

A system of sewers to cost from $15,000 to $20,000 will be put in at Colfax, Wash., this year.

The town council of Brunswick, Ga., has voted in favor of a sewerage system for that place.

An additional $100,000 has been appropriated for the new lateral sewers at Providence, R. I.

A system of sewerage has been ordered surveyed in the southwestern part of Pueblo, Col.

An additional $100,000 has been appropriated for the new lateral sewers at Providence, R. I.

The Portland & Rochester Railway will build a sewer at Portland, Maine, from Saco to Central streets.

The council of Brunswick, Ga., has voted in favor of a system of sewerage and bids will soon be asked.

An ordinance to issue $2,000 bonds to construct a sewer on Rich street, Columbus, Ohio, was passed.

Rickson & Thompson are preparing plans and specifications for sewer district 22 at Little Rock, Ark.

J. P. Gaffney is before the council of Cumberland, Md., with a plan for sewering the city, to cost about $200,000.

The council of Denver, Colo., is to be asked for an additional $20,000 to complete the tributary sewers of that city.

Plans for a general sewerage system have been prepared for Niagara Falls, New York, by Engineer Johnson.

About five miles of sewers will be built in North Des Moines, Iowa, early in the spring. Plans have been prepared.

At Togus, Me., the survey is completed for a sewer six miles long from the Soldiers' Home to the Kennebec river.

South Hadley Falls, Mass., is considering the adoption of a sewerage system, as per plans of E. A. Ellsworth, engineer.

The City Engineer of Watertown, N. Y. has been directed to prepare plans for a sewer from Mead to Central avenues.

Mayor Latrobe, of Baltimore, Md., has made arrangements for the immediate construction of the Bush street sewer.

Mr. Thomas Carey, of Clinton, has been engaged in constructing a 22-inch vitrified sewer pipe on Main street, at Lyons, Ia.

The city engineer has been instructed to prepare plans and specifications for several additional sewers at San Luis Obispo, Cal.

A system of sewers for the Tenth Ward of St. Paul, Minn., has been decided upon by the city engineer. Estimated cost, $225,000.

Adams Bros., of Zanesville, Ohio, made the lowest bid on the south branch of the Indianola sewer at Columbus. Their bid was $6,697.60.

Details of proposed new sewerage system at Passaic, N. J. will be given by the City Engineer. Bonds are to be issued for payment of same.

The sum of $50,000 has been appropriated for sewers on Merrimack, Sullivan, Amherst, South Maine and Harrison streets at Manchester, N. H.

City Engineer Ludden reports that sewers aggregating 17,980 feet and estimated to cost $91,733 should be constructed as soon as possible at Detroit, Mich.

The city attorney is authorized to correspond with civil engineers regarding surveys and estimates for a complete sewerage system for Santa Fe, New Mexico.

The contract for section 2 of the trunk sewer to be built at Marquette, Mich., has been awarded to Wm. O'Meara at $1.40 per lineal foot. John Mitchell received the Prospect street sewer contract; eight-inch pipe, 74 cents per lineal foot.

Construction of the new outfall sewer at Lynn, Mass., will soon begin. The plan of Rudolph Hering, of New York, was accepted. The sewer will be 2,400 feet long.

The clerk of the sewer board, at Holley, N. Y., has been authorized to employ an engineer to prepare plans and specifications for the proposed sewers for that place.

It has been decided to adopt a system of sewage disposal by gravitation, to cost $70,000 at Revere, Mass., provided the same meets with the approval of the State Board of Health.

The city of Belleville, Mo., has advanced money to defray the expense of construct ing a sewer along B street from the east side of High street to the west side of Race, $3,500.

The Sewer Commissioners of Pittsfield, Mass., have contracted for the pipe to be used in the west side trunk sewer and $8,000 is the estimated saving for the city by purchasing early.

Daly & Loebel were awarded the contract for building a sewer sixty feet long in Ingalls avenue, crossing Ninth street, at Troy, N. Y., and will receive $4.10 per foot for its construction.

The Lewis-Mercer Construction Company, of New York, has been negotiating with the city authorities of Independence, Kan., for the purpose of putting in a sewer system for that point.

The city of San Francisco, Cal., is much stirred up upon the subject of sewers. Engineer Mason says the city has no proper sewerage system, and flushing of the present system will be of little use.

The Portland sewer at Louisville, Ky., is over a mile long and is 11 feet in the clear. It is composed of brick as far as Thirty-fourth street, and from there to the river is of steel. Cost, $145,000.

Certain improvements for New York City have been approved by Commissioner Heintz; including sewers for One Hundred and Sixty-eighth street to use 1,635 feet of twelve inch pipe, and sewer for Locust avenue, in Port Morris.

A contract for the construction of the northwest section of the Garrison creek sewer, at Toronto, Can., has been signed by McKeown & Co. It is to be built of brick, 6 ft. 6 in. in diameter, will be 6,150 feet long, and cost $47,000.

The report of the Committee on Sewers and Drains, at Manchester, N. H., for the year 1891, shows that 17,144 feet of sewers were built, at a total cost of everything, including repairs, etc., of $53,350.61; the average cost per foot was $2.497.

The City Engineer of Cincinnati, Ohio, has transmitted his final estimate and assessing ordinance for the construction of sewers on State avenue, Neave and other streets, by T. J. Peter, and recommended their adoption. Total costs of improvement amounts to $16,910.

A New York firm has made a proposition to the city of Lonaconing, Md., to construct a system of sewers for the town at their own expense and to make their profit by annual payments of property owners for the privilege of discharging the drainage from houses into the pipes.

WATER-WORKS.

Akron, Ohio, wants water-works.

Water-works are being built at Belt, Mont.

Bellevue, Ohio, talks of erecting a new stand-pipe.

Anderson, Ind., will build a $100,000 addition to her water-works.

The water-works system of Uniontown, Ala., is being rapidly erected.

Reading, Pa., is preparing for a first issue of $75,000 in new water bonds.

A system of water-works will be put in at Nappanee, Ind., to cost $25,000.

The laying of the water-works pipe at Opelika, Ala., is progressing rapidly.

A stand-pipe system of water-works has been decided upon for St. Joseph, Mich.

Clifton Springs, N. Y., is contemplating the expenditure of $20,000 for water-works.

It is proposed to expend $45,000 in a system of water-works for Shenandoah, Pa.

The improvement of the water-works plant at Duluth, Minn., last year, cost about $20,000.

Levi K. Mansfield has assumed charge of the water-works department at Bridgeport, Ct.

A. Igo, Greeley, Col., has received the contract for building water-works at Rawlins, Wyo.

The council of Granite Falls, Minn., is investigating the most desirable system of water-works.

A 1,000,000 gallon tank will be added to the water-works of Lansdowne, Pa., in the early spring.

The contract for the Apishapa reservoir, near Trinidad, Col., has been awarded to J. R. De Remer.

Negotiations for water-works at Oxford, Ala., are nearly completed with a Philadelphia company.

A water-works company, with capital stock of $250,000, has been formed at Pachuca, Mex.

The Hammonds Water-Works Company incorporated with capital stock of $50,000 at Hammond, Ind.

A village charter has just been accepted which authorizes the building of water-works at Cherryfield, Me.

The city engineer of Minneapolis, Minn., has been instructed to advertise for bids for this year's water pipe.

$40,000 have been subscribed by the citizens of Mt. Vernon, Ill., with which to build a system of water works.

Hiawatha, Mo., has a $50,000 water-works system, which furnishes water for the whole city and two railroads.

A company with a capital stock of $50,000 has been incorporated to supply Everett, Wash., with water.

Geo. H. Utter, of Silver City, will superintend the building of extensive water-works at Chihuahua City, N. M.

Eighteen and one-half miles of water pipe is what the light and water company intends to lay next spring at Tacoma, Wash. This amount of pipe is now on its way from Philadelphia.

The sum of $16,000 has been appropriated for the purchase of new mains during the next year for Newton, Mass.

Bonds to the amount of $10,000 will be issued to pay for proposed improvements to the new reservoir at Orange, N. J.

An ordinance has been passed to increase the capacity of the water mains in the western district of East Saginaw, Mich.

A committee has been appointed by the council of Madisonville, Ohio, to report on the building of water-works for that place.

The water-works committee has decided to adopt the gravity system for water-works at Plymouth, Mich. Estimated cost $30,000.

A new reservoir 260 feet long by 200 feet wide, with a capacity of 2,000,000 gallons is being built for the water-works at Boone, Ia.

It has been reported to the common council of Newbury, N. Y., that $121,000 is necessary to the improvement of the present water-works system.

The superintendent of the Belfast, Me., water-works reports that the company laid 2,300 feet of six-inch main and 200 feet of four-inch main last season.

A company has been organized and obtained a franchise from the East Tennessee Land Company to construct a system of water-works at Harriman, Tenn.

The water board at Lynn, Mass., has been authorized to lay 400 feet of water-pipe in Elmwood, and 600 feet in Clark street, Woodland avenue and other streets.

The board of water-works at Manchester, N. H., has been petitioned for a high service water-works to cost $125,000, and same will be considered by the city council.

An underground stream of water has been discovered at Hopkinsville, Ky., large enough for a place of 20 000 people, and a water-works plant will be built at once.

E. Hodge & Co., of East Boston, were awarded the contract for the stand pipe to be erected on Powder House Hill, Portsmouth, N. H. Their bid was for $8,465.

Propositions for furnishing the city of Ludlow, Ky., with a water supply will be received until February 18th. System of supply and kind of water to be furnished must be stated.

Representatives of various commercial bodies have proposed a bill to be presented to the legislature, which provides for the appointment of four commissioners to build a new water-works at Cincinnati, Ohio, with a daily capacity of 100,000,000 gallons at a cost of $6,000,000 or less.

Hyde & Jackson, of New York, are asking for a franchise to put in a $100,000 plant, Holly system with a standpipe, and 70 hydrants at Kaukauna, Wis. The rental of the hydrants is to be $5,000 per year, and each additional one $75. It is proposed to derive the water from artesian wells.

BRIDGES.

The work of excavating for the abutments for the bridge at Ætnaville, W. Va. has begun.

A 500 foot bridge across Rock river at Prophetstown, Ill., has been voted by the county board; estimated cost being $16,000.

An iron bridge is to be built across the Zumbro river at Kenyon, Minn.

The sum of $3,000 has been appropriated for repairs to the Webster street bridge at New Haven, Ct.

Lyman L. Gerry will give details of proposed bridge necessary to the extension of Essex street, Dover, N. H.

At East Chatham, N. Y., the old wooden bridge leading toward Canaan, is to be replaced by an iron bridge.

The sum of $160,000, to be raised by bond issue, will be expended on the proposed L street bridge at Boston, Mass.

A petition for the erection of a bridge at Monroe street, Chicago, Ill., is being circulated in the eighteenth ward.

An iron bridge 30 feet wide is to be constructed over the Central, New England and Western tracks at Hartford, Conn.

The county commissioners have ordered a new bridge to be constructed across South Table creek at Nebraska City, Neb.

The city engineer has prepared plans for an iron bridge over Perry Creek at Fourth street, Sioux City, Ia. It will cost about $4,000.

E. G. Tompkins and Joseph Adams have petitioned for an iron bridge across Cedar river at the south end of Main street, Austin, Minn.

The Louisville & Nashville railroad intends erecting a bridge over the Ohio river at Maysville, Ky., and extend its lines to Columbus, Ohio.

An appropriation of $2,000 will be made by the county commissioners of Cowley County, Kas., to build a bridge over Grouse Creek, at Winfield.

The people of Sheperdville, Ky., are considering the question of having a wagon bridge built across the famous old Salt river at that place.

At Mt. Clemens, Mich., the question of constructing a bridge across Clinton river at the foot of Macomb street and Crocker avenue is being agitated.

It is stated that the Chesapeake & Ohio Railway Company contemplates the construction of a bridge over the Ohio river, connecting Ironton, Ohio, with Russell, Ky.

The South-Western Bridge Company incorporated with $100,000. The company will construct self supporting suspension bridges. W. B. Woody of Rockdale, Texas, is president.

The clerk of the town council of Scottdale, Pa., will give details of proposed overhead bridge over the southwest railroad to connect with the 50-foot bridge leading to the Kiefertown bridge.

At Toledo, Wash., the county auditor of Lewis county will receive bids until Feb. 4th for the construction of a combination bridge, 270 feet span with one approach 520 feet long at that place.

Plans have been completed for the proposed Twelfth street bridge at St. Louis, Mo. The structure will be 2,100 feet long, with a 30-foot roadway, and two 10 feet side-walks. The estimated cost is $250,000.

The city engineer of Harrisburg, Pa., has completed the plans for the proposed iron bridge over the Philadelphia and Reading Railroad tracks at Cameron street. It will be a plate girder structure 100 feet long.

NATIONAL BRICK-MAKERS' ASSOCIATION.

Arrangements have been made by which the Indianapolis delegation will leave via the "Big 4" and Chesapeake and Ohio Routes at 3:00 P. M., Sunday, January 10, using the celebrated "F. F. V." of the C. & O. from Cincinnati, which is scheduled to reach Washington at 2:10 the next afternoon.

The F F. V. is a Solid Vestibuled Train composed of the finest Pullman Sleepers, Coaches and Dining Cars, heated by steam and lighted by electricity and provided with all modern appliances; said to be the finest train in the world. The C. & O. traverses the most interesting portion of Virginia, along the banks of the Ohio and Kanawha rivers, crossing the Allegheny and Blue Ridge Mountains, and passing through the most picturesque regions of America.

This route has another train almost if not quite as fine as the F.F.V., called the "Washington Fast Line;" also a Solid Vestibule Train leaving Cincinnati at 7:35 A. M. and scheduled to arrive in Washington at 6.35 the next morning.

The following schedule will show the proper trains to take via the above route:

	"Big 4" Train No. 18. C. & O. "F. F. V."	"Big 4" Train No. 12. C. & O. "Wash. Fast Line."
Lv. Chicago	9:15 A. M.	8:30 P. M.
" La Fayette...	1:06 P. M.	1:20 A. M.
" Peoria, Ill....	†7:10 A. M.	7:45 P. M.
" Bloomington	†9:00 A. M.	9:37 P. M.
" Champaign..	†10:30 A. M.	11:15 P. M.
" St. Louis.....	8:05 A. M.	7:55 P. M.
" Terre Haute.	1:00 P. M.	1:34 A. M.
" Indianapolis	3:00 P. M.	3 55 A. M.
" Cincinnati...	6:10 P. M.	7:35 A. M.
Ar. Washington.	2:10 P. M.	6:35 A. M.

All the above trains are daily, including Sundays, except those marked †.

"Big 4" No. 18 is the Celebrated Southwestern Limited from St. Louis to Indianapolis and a Solid Vestibule Train from Chicago and Indianapolis to Cincinnati. "Big 4" No. 12 is also a Solid Vestibule Train from Chicago and Indianapolis to Cincinnati, and has through Sleepers from both St. Louis and Peoria to Cincinnati.

The rates for this occasion are one and one-third fare on the certificate plan. Parties should purchase tickets via the "Big 4" and Chesapeake and Ohio at regular rate via that route to Washington, and get certificates from the agent entitling them to return tickets at one-third fare.

Sleeping car rates from Cincinnati are $3 00 per double berth.

Sleepers will start from Cincinnati. For sleeping car accommodations and other information please address or call upon agents of the "Big 4" or C. & O.

H. M. BRONSON, A. G. P. A., Big 4, Indianapolis.
C. B. RYAN, D. P. A., C. & O. Ry., Cincinnati, O.
A. S. MILLER, T. P. A., C. & O. Ry., Indianapolis.
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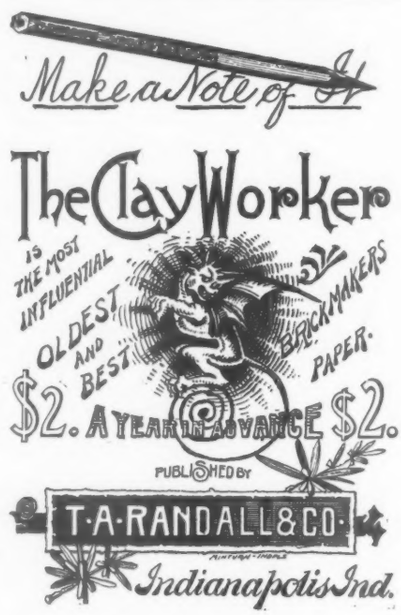
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NATIONAL BRICK-MAKERS' CONVENTION.

The annual convention of the National Brick-makers' Association will be held at Washington, D. C., January 12th to 16th, inclusive, 1892.

Liberal arrangements have been made for the transportation of members and others to Washington, and aside from the business of the conference, congress will be in session and the city will be unusually attractive at this season of the year.

The Baltimore and Ohio railroad, "The Picturesque B. & O," offers cheap rates and special inducements to those contemplating the trip. Its new southwestern limited is equipped with cars built expressly for these trains by the Pullman Company. These cars have all the features of the famous Royal Blue Line trains, which are run via the B & O. between Washington and New York, and include the vestibule, with the anti telescopic device, steam heat, Pintsch gas, and separate toilet accessories for men and women

Its sleeping cars are of the latest design and elegant finish of the Pullman shops and most complete in all of their appointments, especially in the buffet service.

The road crosses the Alleghenies at a high altitude, and at this season of the year the mountains covered with their mantle of snow, are most beautiful. After crossing the mountains on the eastward where the road winds its way along the Potomac, passing through Harper's Ferry, where Old John Brown's Fort may be seen from the train, also other points of historic interest.

An illustrated "Guide to Washington" and complete time table and map of the line will be furnished by addressing the General Passenger Agent at Cincinnati Ohio.

A rate of a fare and one third, on the certificate plan, has been authorized. Parties to secure this rate should purchase first-class limited tickets to Washington, and ask for a receipt or certificate from the agent, and upon presentation of this certificate properly endorsed by the authorized officer of the convention, a return ticket will be sold from Washington back to original starting point at one-third of the first-class limited fare.

For through tickets, sleeping car berths or other information, inquire of ticket agents of connecting lines or address the following representatives of this company.

GEORGE B. WARFEL, Western Passenger Agent, 13 East Ninth street, Kansas City, Mo.
G. M. TAYLOR, Passenger Agent, 105 North Broadway, St. Louis, Mo.
ARTHUR DE ARMAS, Southern Passenger Agent, 34 St. Charles street, New Orleans, La.
C. H. KOENIG, District Passenger Agent, S. E. Corner Fourth and Vine streets, Cincinnati, Ohio.
W. P. TOWNSEND, Traveling Passenger Agent, S. E. Corner Fourth and Vine streets, Cincinnati, Ohio.
E. E. PATTON, Traveling Passenger Agent, Chillicothe, Ohio.

O. P. McCARTY, General Passenger Agent, Cincinnati, Ohio.

REDUCED RATES TO WASHINGTON, D. C., VIA THE PICTURESQUE B. & O.

The National Brick-maker's Convention will be held at Washington, D. C , January 12 to 16, 1892. The Baltimore & Ohio R. R. has arranged to carry delegates and others at a rate of a fare and one-third for the round trip. To secure this rate, parties must purchase first-class limited tickets to Washington, via the B. & O. road, taking receipt or certificate from ticket agent and on presentation of this certificate properly endorsed by the authorized officer of the convention, return tickets will be sold from Washington back to original starting point at one-third of the first-class limited fare.

The "Baltimore & Ohio Southwestern Limited," leaving Cincinnati at 7:20 P. M. daily is an entirely new train to the East. This train is vestibuled throughout, heated with steam, lighted with Pintsch gas, carpeted and is also provided with the anti-telescoping device, and has convenient toilet accessories for gentlemen and ladies. These cars are patterned after the famous Royal Blue Line cars running via the B. & O. between Washington and New York, and are the finest ever turned out by the Pullman shops. The New York express leaves Cincinnati at 8:15 A. M. daily. No extra fare is charged on these trains.

Connecting trains leave St. Louis via the Ohio & Mississippi Railway at 8:00 A. M. and 8:05 P. M., with through Pullman sleepers to Washington.

An illustrated Guide to Washington and complete time table and map of the line will be furnished upon application to the General Passenger Agent of the B. & O S. W. R. R., Cincinnati, Ohio. For through tickets, sleeping car berths and other information, inquire of ticket agents throughout the country or address:

C. H. Koenig, District Passenger Agent, S. E. Cor. Fourth and Vine Sts., Cincinnati, O.
W. P. Townsend: Traveling Passenger Agent, S. E. Cor. Fourth and Vine Sts., Cincinnati, O.
E. E. Patton, Traveling Passenger Agent, Chillicothe, O.
G. M. Taylor, Passenger Agent, 105 North Broadway, St. Louis, Mo.
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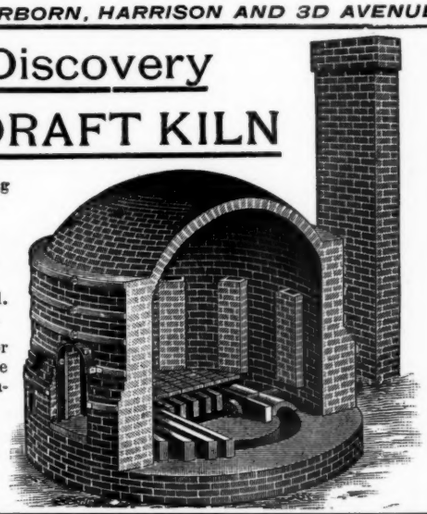

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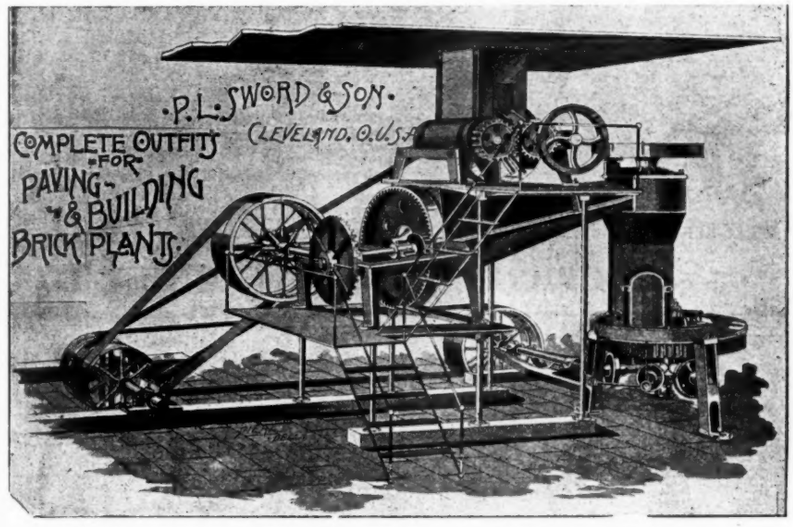

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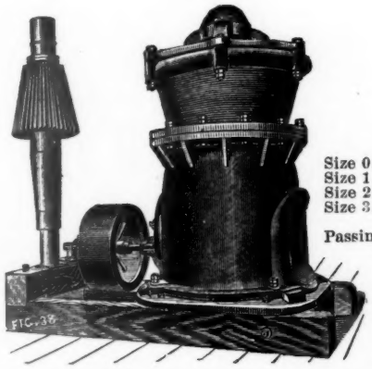

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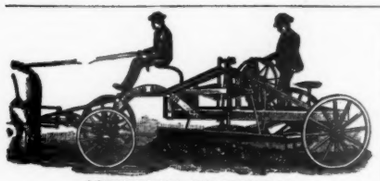

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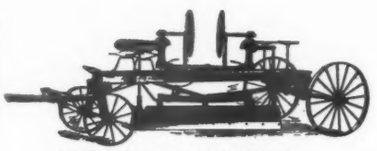

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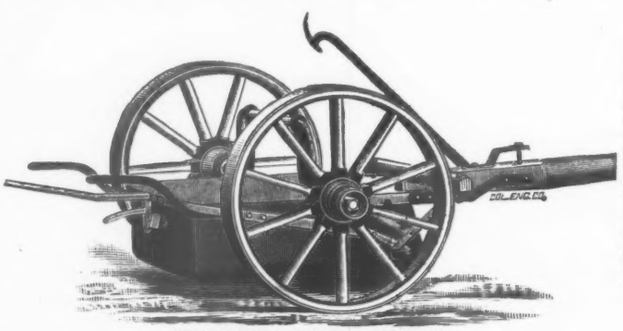

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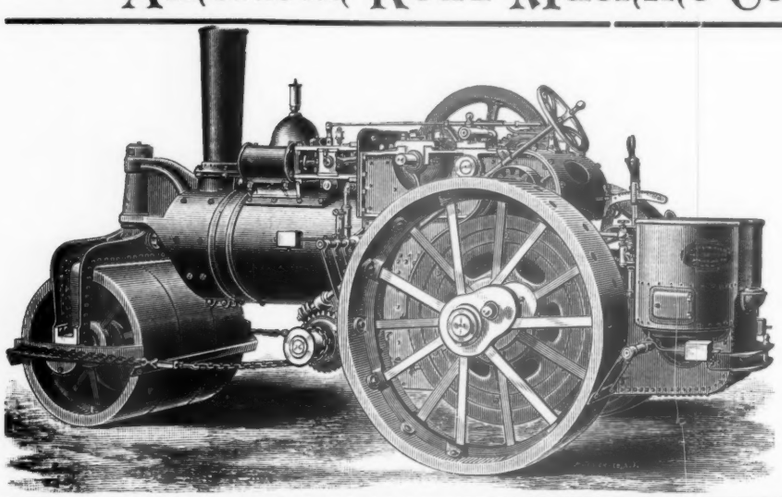

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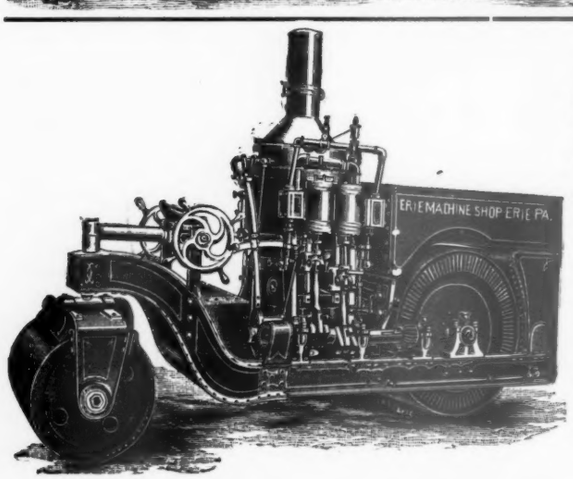

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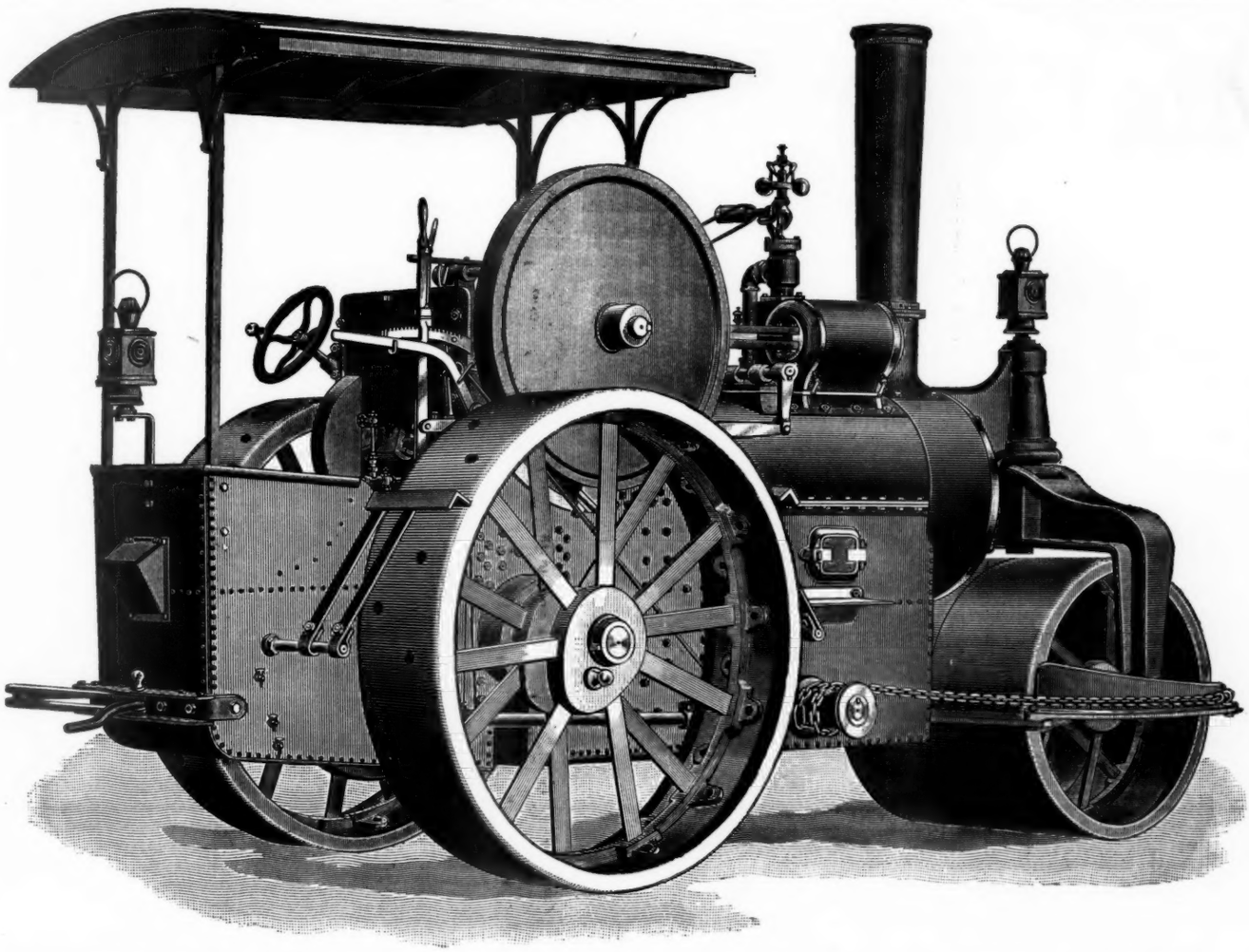

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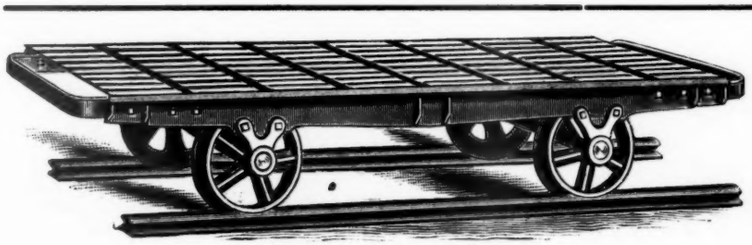

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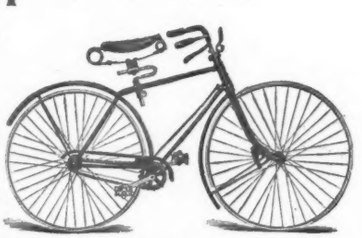

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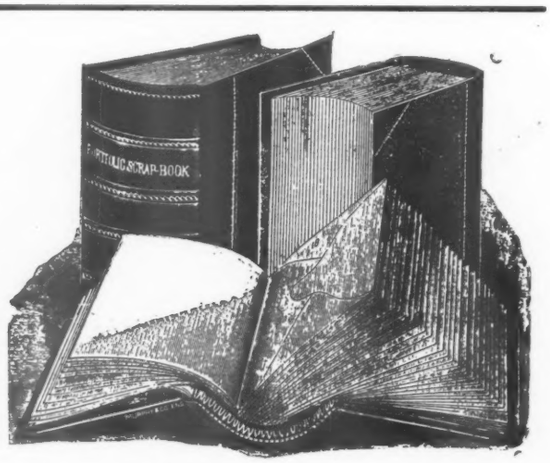

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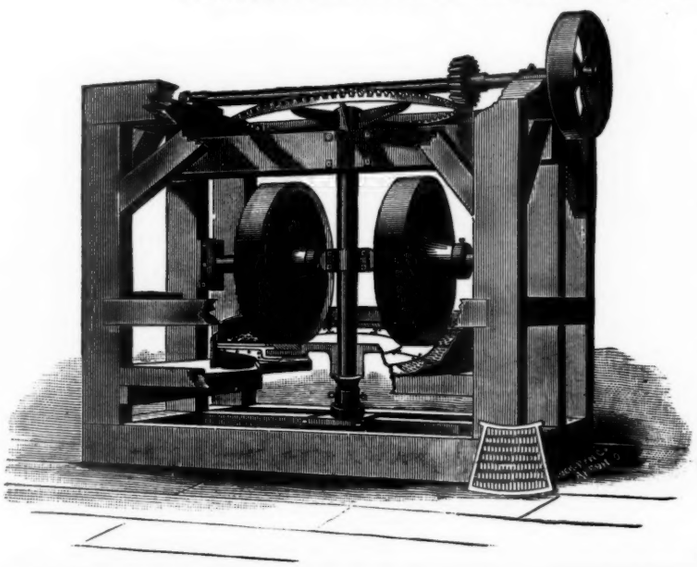

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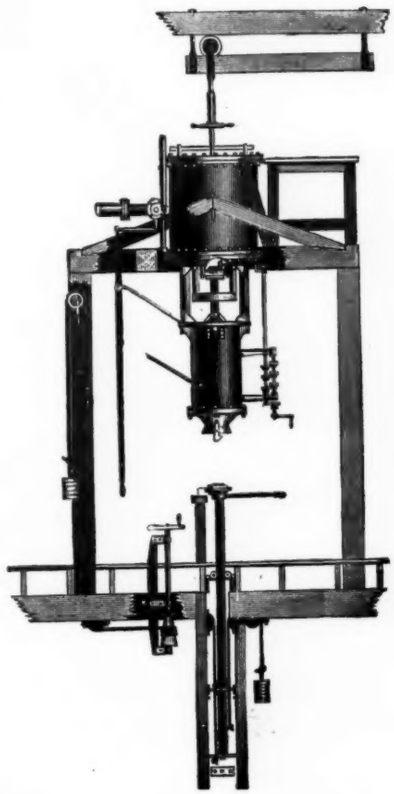

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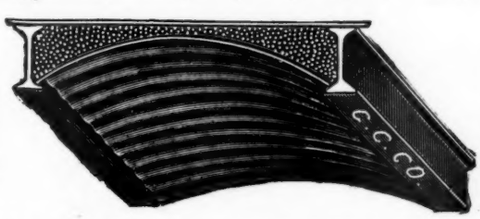

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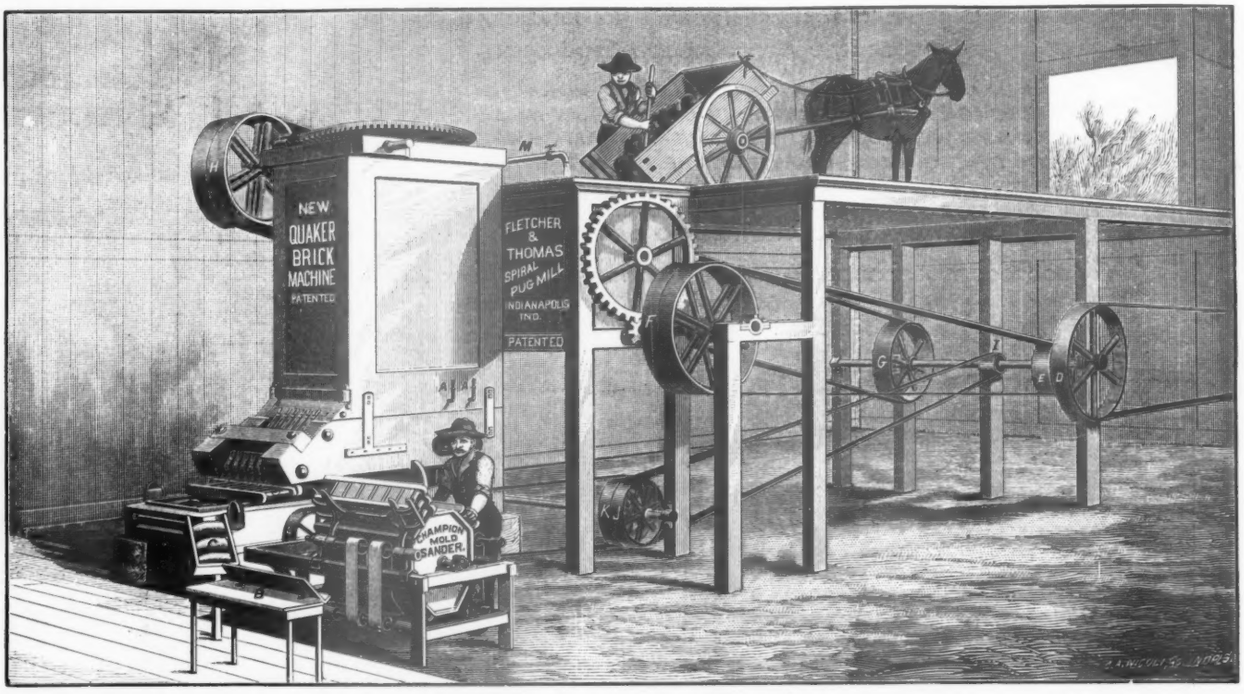

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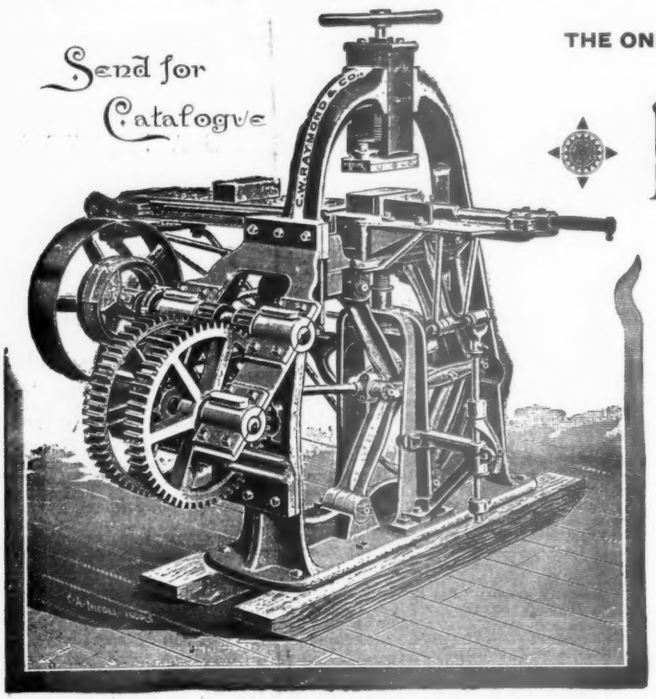

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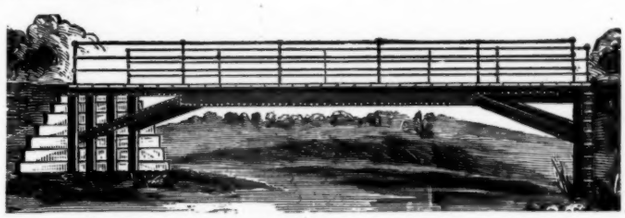

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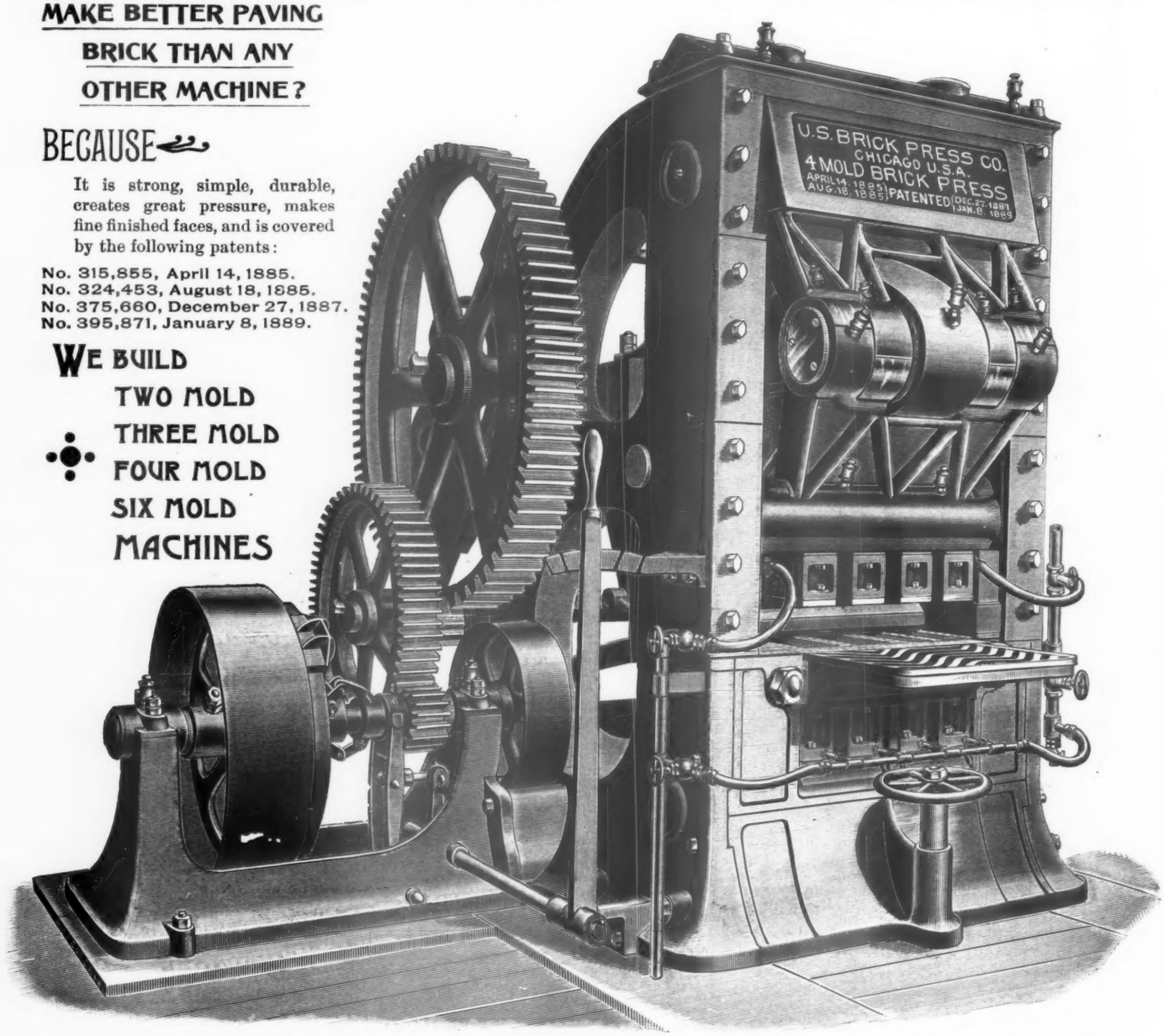

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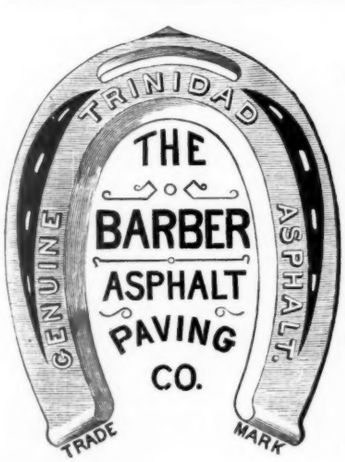

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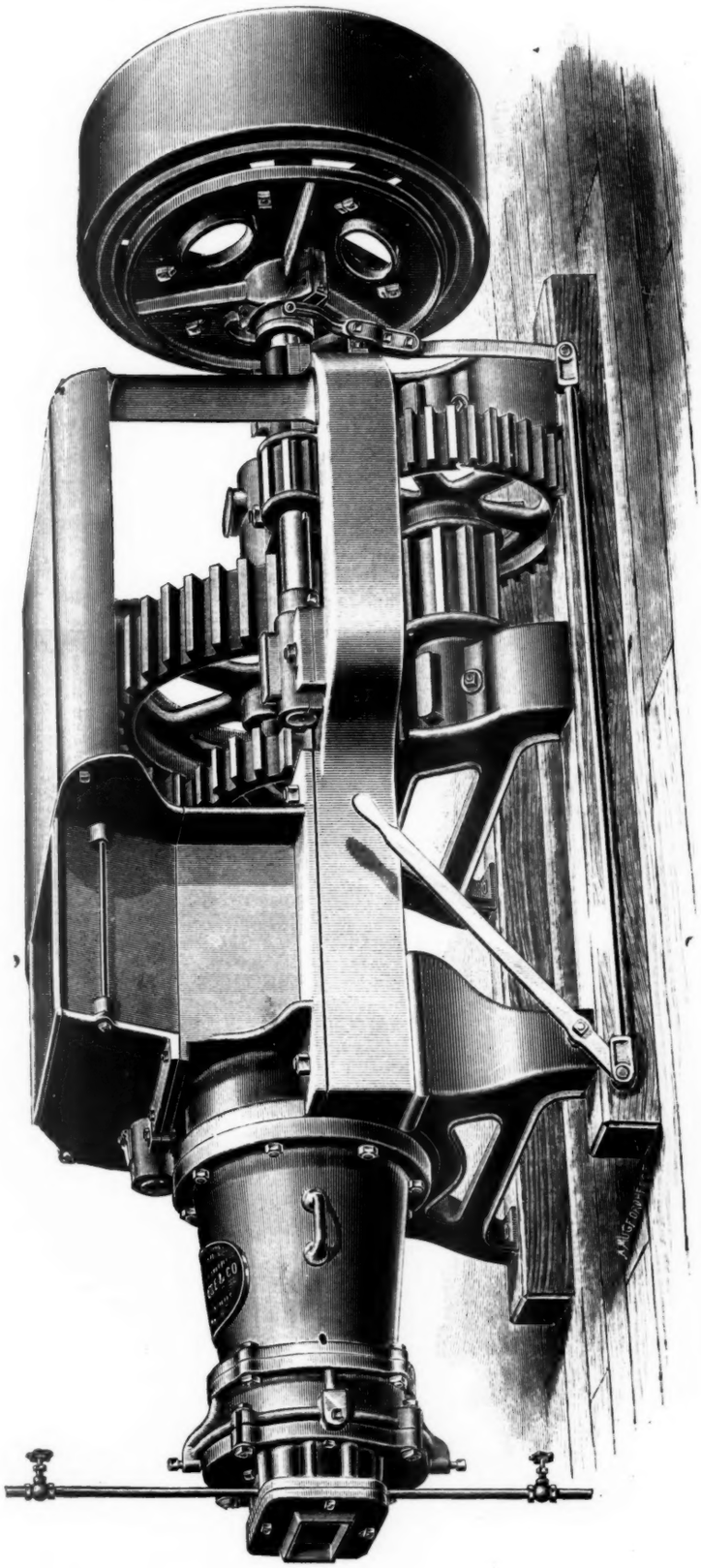

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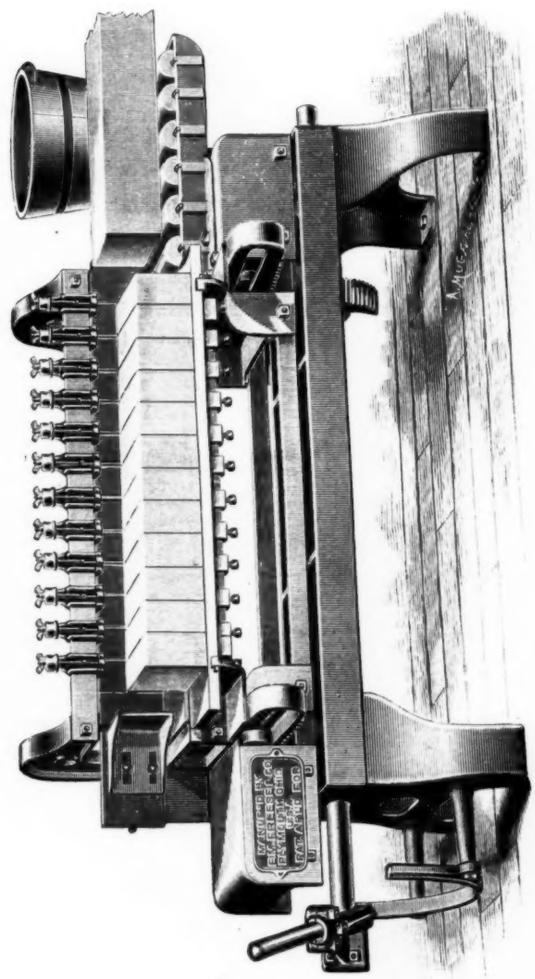

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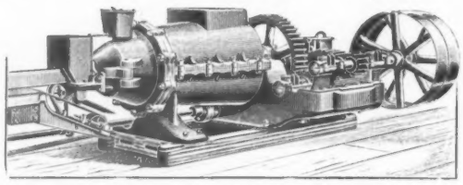

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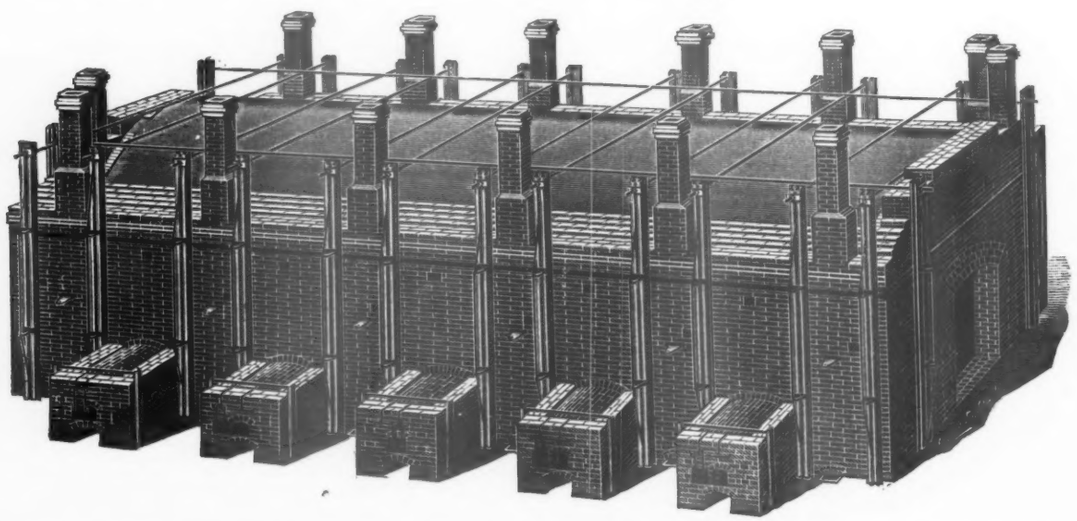

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